SCIENCE

VOL. 81 | FRIDAY, JANUARY 4, 1935 | No. 2088

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE ATMOSPHERES OF THE PLANETS[1]

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Two ways are open to the retiring president of this association, when he makes what small return he can for the honor of his election. By a sound and time-honored custom, it is his duty and privilege to speak of some topic, within his own technical field, but of general interest. He may therefore either report on his own researches—if he is fortunate enough to have recent or unpublished results good enough to measure up to the standard of a presidential address—or he may survey some section of his part of the field of science in which important gains have lately been made, though his own contribution to this advance may be small. Only the latter course is open to the present speaker: and so, this evening, we may devote a little time to the atmospheres of the planets.

As soon as telescopes became good enough to give a tolerable view of details on the planets, evidence began to accumulate that some of them, at least, possessed atmospheres. Doubtless the first to be noticed were the changes in the markings on Jupiter, which differ radically from one year to the next, and often appear suddenly and last but a few weeks, though thousands of miles in diameter. Only clouds, forming and dissolving in a Jovian atmosphere, can account for such rapid and capricious changes.

Evidence for an atmosphere on Mars is afforded by the polar caps. The steady shrinkage of these during the summer, accompanied by the growth of the opposite cap during the long, cold polar night, is explicable only by the melting or evaporation of deposits of some snow-like substance, which is carried as invisible vapor to the opposite pole, and there deposited. A permanent, non-condensible atmosphere is required for the transport of this vapor.

Venus, when she is considerably nearer to the

[1] Address of the retiring president of the American Association for the Advancement of Science, Pittsburgh, December 31, 1934.

earth than to the sun, shows a crescent phase, like that of the moon, and for the same reason. As she comes more nearly into line between us and the sun, her crescent narrows, and the horns begin to project beyond their normal positions, so that she has been seen as three quarters of a circle, and even as a thin bright ring, with a dark interior. This remarkable phenomenon can be seen only when Venus is within about a degree of the sun, and no chance to observe it again will occur till near the end of the present century; but it has been recorded in the past by several competent observers. Such an extension of the horns—and, above all, the ring-phase—can be explained only as effects of twilight, the illuminated atmosphere of the planet being visible across the narrow dark strip of its surface on the side farther from the sun.

For the three brightest planets, then, the presence of an atmosphere is proved by observation, in three quite different, but equally conclusive ways, all of which were well known to astronomers before the end of the eighteenth century.

Later observations have added evidence of the same type—a few white spots on Saturn, appearing at irregular intervals of some decades, which change shape, shift and disappear as clouds would do; occasional though fugitive clouds, and a measurable effect of twilight, upon Mars; and elusive markings on Venus, which can be photographed only with ultra-violet light, and change greatly between one evening's observations and the next. The extent of atmosphere can also be roughly estimated from the results of direct telescopic observation. The surface details of Jupiter (and of Saturn when any appear) may be seen, and photographed, close up to the limb, despite the very oblique angle of view. It is therefore evident that there can be no such extensive gaseous mantle as veils the earth. At least, there is none above the visible cloud-surfaces of these great planets—how much there may be below is another matter. The rarefied layer which exists, however, suffices to cut down the apparent brightness of the edge of the planets' disks. The effect of contrast against a dark sky conceals this in an ordinary telescopic view; but the first look at one of these planets in strong twilight shows that it is actually of surprising magnitude.

There is more "limb-light" on Mars, and there may be more atmosphere above the visible surface—the real surface, this time; but an atmosphere as thick as the earth's, even if free from clouds or haze, would produce a much greater effect.

For Venus the layer which produces the elongation of the crescent is remarkably thin, rising only about 4,000 feet above the visible surface. But this represents only the part of her atmosphere which is hazy enough to be seen through the glare of our own sky close to the sun. The top of the atmosphere must be much higher; and the bottom, if the visible surface is composed of clouds, much lower, so that its whole amount may be great.

The celestial body which we can observe in far the greatest detail tells quite another story. The moon, viewed telescopically, shows no more atmosphere—whether in the artist's or the physicist's sense—than a bare plaster cast illuminated by a powerful searchlight. Far more delicate tests are possible here than in other instances, and neither refraction nor twilight is present to the minutest degree. Our satellite is naked rock *in vacuo*. Mercury, too, appears to be without an atmosphere, though the evidence is less detailed.

The existence of atmospheres on the majority of the planets—though not on all—is thus established by direct telescopic observation. To determine their composition, we must, as usual, have recourse to the spectroscope: but we meet with two difficulties.

In the first place, many possible atmospheric constituents show no selective absorption whatever in the region accessible to our study. Hydrogen, nitrogen, helium, neon and argon belong in this group, and are hopelessly beyond the reach of our investigation. Secondly, the other gases of the earth's atmosphere absorb too much for our advantage. The worst by far is ozone. Though present in but small amounts, and mainly in the higher layers, it cuts off the whole spectrum short of 2,900 Angstroms, and deprives us of any hope of studying the most interesting parts of all celestial spectra.

Were we working in the infra-red, water-vapor would be almost as troublesome. There are long stretches of the solar spectrum, within the range of present-day plates, in which we can find out little or nothing about the sun's own spectrum. The great wide lines of the water-vapor bands, often overlapping, hide almost everything else. The band near 11,500 A is quite hopeless; that at 18,000 would be worse, if our photographs got so far; one near 9,600 is still very bad; while in those near 8,200 and 7,200 the solar lines can be picked out, with care, among their stronger telluric neighbors.

Oxygen reveals itself by a strong band, with very regularly spaced lines, at λ 7,594 (Fraunhofer's A), the weaker B band near 6,867, and the much fainter α band at 6,277. The terrestrial origin of all these lines is conclusively settled by two tests: first, their changes with the altitude of the sun (varying the air-path) and, for the water-vapor lines, with weather conditions; second, the absence of the Doppler shift, due to the sun's rotation, when light from the east and west limbs is compared. The absence of even faint components of solar origin is explained by the

high temperature, which dissociates such molecules completely.

The intensities of these bands are in inverse order of the abundance of the molecules which produce them —an apparent anomaly, explained by the circumstances of their origin. The ozone band is part of the main system of the O_3 molecule, and, like all such bands, is very intensely absorbed, a layer of the gas, at its worst, being as opaque as one of metal of equal mass per square centimeter. For water-vapor the main absorption bands lie far in the infra-red, and are very strong—those with which we are now concerned involve high harmonics of the fundamental vibrations. The coefficient of absorption, and the intensity of the bands, diminishes rapidly with increasing order of the harmonics and diminishing wave-length.

The oxygen bands are produced by a "forbidden" transition within the molecule, for which the probability of absorption is exceedingly small. This is why the whole mass of oxygen above our heads (equivalent to a layer two kilometers thick at standard temperature and pressure) produces absorption lines no stronger than the sodium vapor in a Bunsen flame an inch thick, which contains but a minute percentage of the vapor of the metal. The principal bands of oxygen, in the ultra-violet beyond λ 1,800, are so strong that light of shorter wave-length can not be observed at all in air. The experimenter must put his whole spectroscope in a gas-tight case, and pump it out to an almost perfect vacuum.

In the visible spectrum, the portions cut out by oxygen or water-vapor are very small in extent; but they come exactly in the wrong place—in other words, they hide, line for line, absorption by these same gases which might be produced in the atmosphere of a planet.

If the planet's atmosphere was decidedly richer in either constituent than the earth's, we might detect the fact, for the lines in the planet's spectrum would be stronger than in that of the moon. Comparisons of this sort, however, must be made with great precautions. The moon and planet must be at the same altitude when the observations are made (to get equal air-paths). It is not safe, either, to observe the planet early in the evening and wait till the moon rises to the same height, for a change in temperature may have caused the precipitation of water out of the air, though the oxygen, of course, remains the same. With sufficient patience, a time may be found when planet and moon can be seen together, at equal altitudes, and observed almost simultaneously, with the same instrument.

Early observations of this sort were supposed to show the presence of oxygen and water-vapor on Venus and Mars; but the careful and accurate work of Campbell, in 1894, led him to the conclusion that there was no perceptible difference in the strength of the bands in the two cases, and hence that the amounts of these two important substances, above the visible surfaces of either planet, did not exceed one fourth of those above an equal area of the earth's.

A more delicate, and very ingenious, test was invented, independently, by two distinguished American observers, Lowell and Campbell. When Mars (or Venus) is approaching us, or receding, most rapidly, the lines in its spectrum are displaced by the Doppler shift, while lines produced in the earth's atmosphere are of course unaffected. Were this shift great enough the planetary and telluric lines would appear double, and the former, even though faint, could readily be detected. The greatest available shift is not enough to resolve the lines completely; but measures of the blended lines suffice to show whether any important planetary contribution is present. A still more delicate test is afforded by microphotometer measures of the contours of the lines, which would reveal even a slight asymmetry. These observations are very exacting—requiring high dispersion and a great deal of light—so that the best evidence is that from the great coudé spectrograph of the 100-inch telescope at Mount Wilson. St. John and Nicholson found, in 1922, that there was no perceptible trace of planetary lines in Venus, and Adams and Dunham, in 1934, have come to the same conclusion in the case of Mars. An amount of oxygen, on either planet, equal to a thousandth part of that above an equal area on earth, could certainly have been detected. For water-vapor, the tests have so far been less delicate, and are not fully decisive—though the quantity present on either planet must be small. More delicate tests, with stronger lines, may soon be made on new red-sensitive plates.

There can be no reasonable doubt, on quite different evidence, that some small amount of water-vapor is actually present in Mars' atmosphere. Radiometric observations of the planet's heat show definitely that the surface rises to temperatures above 0° Centigrade at noon every day in the Martian tropics, and at the pole at midsummer, though falling far below freezing at night. The polar caps must therefore really be composed of snow, and evaporate into water-vapor, even if the pressure is so low that the ice turns directly into vapor without melting. The only plausible alternative suggestion—carbon dioxide—would volatilize at much lower temperatures than the actual polar caps do. But, judging from the amount of solar heat available to evaporate them, the polar caps must be very thin—probably only a few inches

thick. The vapor resulting from the gradual sublimation would never attain any considerable density, and might easily fail of detection by the tests which have so far been practicable.

No such independent evidence is available for Venus, but Adams and Dunham, in 1932, discovered, in the infra-red region of her spectrum, three beautifully defined bands with heads at λ 7,820, λ 7,883 and λ 8,689, and evidently of atmospheric origin. They had not then been observed elsewhere; but an immediate suggestion regarding their origin was obtained from the theory of band-spectra—by that time well developed. The spacing of the individual lines in a band arises from the rotation of the molecule and depends upon its moment of inertia. For the new planetary band, it showed that the otherwise unknown molecule involved must have a moment of inertia of 70.5×10^{-40} c. g. s. units. This agreed almost exactly with that of the molecule of carbon dioxide—already known from laboratory observations in the infra-red. All doubt regarding this identification was removed when Dunham, passing light through 40 meters of CO_2 at a pressure of 10 atmospheres, found that the strongest of the bands found in Venus was faintly absorbed. Recently Adel and Slipher, using a path of 45 meters through gas at 47 atmospheres' pressure, have found the bands considerably weaker than they appear in the planet. They conclude that the amount of carbon dioxide above the visible surface of Venus is at least two mile-atmospheres—that is equivalent to a layer two miles thick at standard atmospheric pressure and temperature. The whole amount above the planet's solid crust may be much greater. For comparison it may be noted that the whole atmosphere of the earth amounts to five mile-atmospheres, and the oxygen in it to one and a quarter.

These bands do not show in the solar spectrum, even when the sun is setting. But there is very little CO_2 in the earth's atmosphere, and the whole amount in the path, even at sunset, amounts to only thirty feet under standard conditions.

The weak absorption in these bands, like that in the visible bands of water-vapor, arises because they involve high harmonics of the fundamental vibration-frequencies—in this case the fifth.

So far we have had to do with bands of familiar and readily identified molecules; but the major planets have been much more puzzling.

Jupiter shows a conspicuous band in the orange, which was discovered visually by Huggins in the earliest days of spectroscopy, and fainter ones in the green. These appear more strongly in Saturn, but only in the spectrum of the ball of the planet, and not at all in that of the ring—which might be anticipated, since the ring consists of a multitude of tiny isolated satellites, and should be quite devoid of atmosphere. Uranus, though its light is faint, shows the same bands, much more strongly, and many others in addition. One of these, which closely coincides with the F line of hydrogen (λ 4,861) led Huggins to conclude that the planet's atmosphere was rich in hydrogen.

This interpretation, though quite permissible at the time, was erroneous, for the line is absorbed only by dissociated *atoms* of hydrogen, which will not be present except at very high temperatures.

The bands cut out so much of the red and orange light that the whole disk of Uranus appears decidedly green—an unusual color, noticed from the time of the planet's discovery.

In Neptune's spectrum, the bands are of enormous strength, cutting out the red almost entirely and making the planet look still greener. They are hard to observe visually in so faint an object, and the full realization of their intensity came only with the admirable photographs of V. M. Slipher, in 1907. In later years, and with modern plates, Slipher has extended his observations far into the red, finding bands of ever-increasing strength—up to λ 10,000 for Jupiter, where there is light enough to follow the spectrum farthest.

For more than sixty years after their first discovery, and twenty-five after Slipher's spectrograms, these bands presented one of the principal unsolved puzzles of spectroscopy—for no one had duplicated them in the laboratory. To be sure, one group, near λ 7,200, agrees fairly well with a band of water-vapor—but the still stronger water-bands deeper in the red are absent, so that this must be a chance coincidence.

When the radiometric measures of Coblentz and Lampland, and of Nicholson and Pettit, showed that the temperature of the visible surfaces of Jupiter and Saturn must be well below $-100°$ Centigrade—while Uranus and Neptune are doubtless colder—the range of possibilities was very much narrowed. But it was not until 1932 that a young and brilliant German physicist, Rupert Wildt, realized the solution of the problem.

Other gases, like water-vapor and carbon dioxide, have strong fundamental absorptions in the infra-red, and fainter harmonics in the more accessible part of the spectrum, which demand a long absorbing path in the laboratory to bring them out. Utilizing observations of this sort, Wildt showed that certain bands in the spectrum of Jupiter near λ 6,470 and λ 7,920 agreed with those of ammonia, and others, at λ 6,190, λ 7,260 and λ 8,860, with bands of methane. The original comparison was not quite conclusive, for with the moderate dispersion then employed the planetary bands had not been adequately

resolved into their component lines. This was soon accomplished by Dunham, who found so complete a coincidence of the accurately measured individual lines that both identifications were put beyond all question. For ammonia more than sixty lines were found to agree, and for methane 18 lines in part of one band. Some expected band lines were naturally blended with solar lines, but not one of importance failed to appear.

From these comparisons Dunham estimates that the quantity of ammonia gas above the visible surface of Jupiter is equivalent to a layer ten meters thick under standard conditions. In Saturn it is less.

The climax of the tale came this year, when Adel and Slipher announced that practically all the bands had been identified, and were due to methane. The 45-meter path and the 40-atmosphere pressure got enough of the gas into the way of the light to produce bands intermediate in intensity between those in Jupiter and in Saturn. At this high pressure the lines flowed together, and produced diffuse bands; but the agreement of these with the planetary bands was so complete as to be decisive.

A further, and wholly conclusive, test could be added. The fundamental frequencies of vibration of the methane molecule were already known, from observations in the infra-red. For the higher harmonics of these vibrations the frequencies are not exact multiples of the lowest, but nevertheless bear a simple numerical relation to them (as is well known in the case of other gases). Applying this test, the strongest bands (including Huggins' band in the orange, and the one coincident with the blue hydrogen line) were found to be harmonics, from the third to the eighth, of one of the fundamental frequencies, while another slower vibration was represented by all its harmonics from the eighth to the sixteenth. The remaining bands were accounted for by combinations of these harmonics with other known frequencies, all of types consistent with the well-established rules which govern band spectra. Thirty-six bands in all have been identified. Many of these appear only in Uranus and Neptune, and have not yet been produced in the laboratory, but the harmonic relations just mentioned make their identification certain. The higher gaseous hydrocarbons, ethane, ethylene and acetylene, all have bands in places clear of disturbance by the methane; and all were looked for in vain. All the planetary bands of any importance are accounted for by methane alone—it is a clean sweep.

From the published data, it appears that the amount of methane above the visible surface of Jupiter is of the order of one mile-atmosphere. There must be much more on Uranus, and especially on Neptune; but we can not yet estimate its amount.

There is still plenty of work to do upon these bands, but mainly for the theoretical investigator. Adel calculates that the band at λ 5,430, when fully resolved, should consist of eighteen different overlapping systems of many lines each. Fortunately, the astrophysicist need not wait to draw his conclusions till this has been completely analyzed.

The results of observation can be summarized in a sentence. Large planets have atmospheres containing hydrogen compounds; middle-sized planets, atmospheres containing oxygen compounds; and small planets no atmospheres at all. The reason, in the last case, was found by Johnstone Stoney, in 1897. It is simply that small bodies have not sufficient gravitative power to keep their atmospheres from diffusing away into the vacuum of interplanetary space. At the surface of any planet, there is a certain velocity of escape, depending only on its mass and radius. A body projected from its surface, in whatever direction, with this or any higher velocity, will fly off in a parabolic or hyperbolic orbit and never return—unless, indeed, it meets with some obstacle or resistance on its outward way. For the moon this velocity is 2.4 kilometers per second; for the earth, 11.2; for Jupiter, 60.

Now the molecules of any gas are continually flying about in all directions, with average speeds which depend upon their weights. At zero Centigrade the average speed for a hydrogen molecule is 1.84 km/sec; for oxygen, 0.46; for carbon dioxide, 0.39. If an atmosphere of hydrogen could be put upon the moon, every molecule that was moving but a little faster than the average would fly off at once into space, unless it was thrown back by collision with another, and the atmosphere would diffuse away in a very short time. With an escape velocity three times the average speed, enough fast-moving molecules would get away to reduce the atmosphere to half its original amount in a few weeks (according to Jeans). The rate of loss falls off very rapidly beyond this, so that, with an average velocity one fifth that of escape, the atmosphere would remain for hundreds of millions of years.

The moon's surface reaches a temperature exceeding 100° C. during every rotation, and it follows that neither air nor water-vapor could permanently remain above its surface. If at any time in its past history, it has been really hot, like molten lava, it could have retained no trace of atmosphere. For Mercury, the escape velocity is half as great again as for the moon; but the planet, being so near the sun, is much hotter, and it, too, can not retain an atmosphere. Mars, with an escape velocity of 5 km/sec, could not hold hydrogen but should retain water-vapor—as it appears to have done—and all heavier gases. Venus and the earth, at their present

temperatures, should retain even hydrogen, and the major planets would do so even if incandescent.

This reasoning explains the cases of Mercury and the moon, and leads to the important conclusion that all smaller bodies, such as the asteroids and satellites, must be wholly devoid of atmosphere—except perhaps bodies like Neptune's satellite, which is relatively massive, and must be very cold. We can not be sure about Pluto, for we know neither its size nor its mass; but it is probable that, at most, it may have a thin atmosphere, like Mars.

The same principle was invoked, shortly after its discovery, to explain the great difference in mean density between the major and the terrestrial planets. The moon, Mercury, Mars, Venus and the earth all have densities between 3.3 and 5.5 times that of water. The rest are almost certainly what we know the earth to be, spheroids of rock, with cores of metallic iron of varying sizes. For the major planets, the densities range from 1.6 for Neptune to 0.7 for Saturn. Moulton suggested, about 1900, that they contained great quantities of light substances, which the smaller terrestrial planets had not been able to keep from diffusing away into space. This has been fully confirmed by later studies.

From the ellipticity of a planet and the changes in its satellites' orbits caused by the attraction of its equatorial bulge, information may be obtained regarding the degree to which the density increases toward its center. Applying this to Jupiter and Saturn, Jeffreys concludes that they contain cores of rock and metal, like the inner planets, surrounded by vast shells of ice—frozen oceans thousands of miles deep—and above this, again, atmospheres of great extent. Throughout most of the atmospheres, the pressure must be so great that the gas is reduced to a density as great as it would have if liquefied, or even solidified, by cooling. Indeed, Wildt believes that the enormous pressure would actually solidify even the "permanent" gases.

Now this outer layer is of low density—less than 0.78 for Jupiter and 0.41 for Saturn—according to Wildt's calculations. This excludes all but a few possible constituents. Frozen oxygen has a density of 1.45, nitrogen 1.02, ammonia 0.82. Only hydrocarbons (methane 0.42, ethane 0.55), helium (0.19) and hydrogen (0.08) come within the limits even for Jupiter. We can therefore conclude, from considerations of density alone, that the outer parts of Jupiter probably, and of Saturn certainly, contain great quantities of free hydrogen or helium. Uranus and Neptune are similar to Jupiter.

It is generally believed that the planets have been produced, in some way or other, from matter ejected or removed from the sun. No really satisfactory theory of the process of formation has yet been devised; but no other hypothesis has yet done better, and the isolation of the sun and planets in space makes a common origin highly probable.

Now we know the composition of the sun—at least of its outer layers—much better than we do that of the planets. Quantitative spectroscopic analysis, though still beset with difficulties, has advanced far enough to show that most of the sun's outer layers is composed of hydrogen; next come helium, oxygen and carbon, followed by nitrogen, then silicon and the metals. A mass of matter removed from the sun and allowed to cool without serious loss would therefore closely resemble the major planets. If small enough to lose all its atmosphere, it would be like the moon or the asteroids—though there are difficulties in seeing how such small masses could have escaped diffusing away altogether before the more refractory constituents solidified.

The history of a body of intermediate mass is more interesting. Hydrogen and helium would be lost while it was still very hot. So would most of the other light gases such as neon and nitrogen (which at the temperature even of the sun's surface is dissociated into atoms). Free oxygen, too, would escape, but a good deal might be retained in combination with silicon and the metals. As the gaseous mass cooled, by expansion and radiation, drops of molten metal and lava would form within it, as Jeffreys suggests, and fall toward the center, building up a molten core. After the first turbulence was over, there would remain a molten planet surrounded by an atmosphere containing heavy inert gases, such as argon, perhaps some carbon dioxide, and as much of the nitrogen and neon as had failed to escape. Menzel and I, a few years ago, noticed that neon, while apparently fully as abundant in the stars and nebulae as argon, is but 1/500 as abundant in the earth's atmosphere; while nitrogen, which is cosmically an abundant element, showing strong spectral lines, forms but a very small portion of the earth's mass. It appears, therefore, that a mass of the earth's magnitude must have lost almost, though not quite, the whole of its primitive atmosphere.

Still following Jeffreys, it appears that, as the molten earth cooled, the two-thousand-mile deep sea of lava solidified first at the bottom (where the melting point was greatly raised by pressure) and so gradually to the surface. During this process great quantities of gases, mainly water-vapor, must have been evolved from the solidifying magma, and escaped to the surface, forming a new atmosphere which now would not escape, since the surface was cooler. With solidification would come rapid superficial cooling, and an ocean would bathe the rocky crust, leaving an atmosphere of moderate extent. Carbon dioxide—evolved from the magma, and per-

haps partly primitive—would be a major constituent, along with nitrogen, argon, neon and other minor left-overs. The presence of free oxygen seems very unlikely, for practically all volcanic rocks and gases are unsaturated with respect to this element—the former containing much ferrous iron and the latter being often actually combustible when they meet the air.

The present rich supply of oxygen appears to be a by-product of terrestrial life. (This suggestion is more than a century old.) The earth, indeed, may be regarded as an intensively vegetated planet, from whose atmosphere the greedy plants extract the remaining residue of carbon dioxide so rapidly that if it were not returned to the air by combustion, respiration and decay, the whole supply would be exhausted in a decade or so. Oxygen removed from the atmosphere by these processes is speedily returned by plants; but there is another process of slow depletion which is irreversible. During rock-weathering, about half the ferrous iron of the rocks is oxidized to the ferric state. Goldschmidt (from whose admirable geochemical papers the present discussion is borrowed) concludes that the amount of "fossil" oxygen thus buried in the sedimentary rocks is at least as great as that now present in the atmosphere and may be twice as great. An amount of carbonaceous or other organically reduced material equivalent to both the free and the fossil oxygen must also be in the sediments—which is not unreasonable. Given time enough, this inexorable process of rock-decay might exhaust the remaining oxygen of our atmosphere and put an end to all that breathes. But this danger is indefinitely remote—a billion years away anyhow, since life has lasted that long and only half the oxygen has been used up; and probably much longer, for volcanic gases are still carrying "juvenile" carbon dioxide into the air that has never been there before.

It is of no small interest, however, to look at Mars and see there what looks very like the end of this process. The reddish color of the planet—unique among the heavenly bodies—is just what might be expected, and indeed is almost inevitable in a surface stained with ferric compounds. (The unoxidized rocks of the moon are gray or, at most, brownish.) Wildt suggests that, in the thin atmosphere of Mars, the ozonized layer produced by the action of ultraviolet light at the top of the atmosphere should be near the surface—not high up, as it is here—and that oxidation processes at the planet's surface might thus be accelerated.

It would be premature, however, to conclude that Mars must be a lifeless planet. The depletion of oxygen would be very slow, and plant life would probably adjust itself, as it has done on the earth in response to far more rapid climatic changes. Whether animal life, if ever present, could have survived, is speculation. A race of no more intelligence and engineering skill than our own could presumably meet the situation and survive in diminished numbers breathing electrolytic oxygen—provided that it paid any attention to changes so slow as to be imperceptible in a thousand generations!

While Mars resembles the final stage of our suggested process, Venus seems to be at the beginning, and much like what a lifeless earth would be. We do not know how life began here, but conditions may well have been much less favorable on Venus. Wildt concludes that the powerful "blanketing" effect of the atmospheric CO_2, combined with the stronger solar radiation, may raise the temperature at the planet's actual surface to 100° C. or higher—in which case the failure of life to develop is not surprising. The real puzzle is the apparent absence of water on Venus' surface. She is almost a twin of the earth in size, mass, density, and so on, and one might have expected an ocean of comparable volume. Wildt suggests that all the water has gone into hydrated minerals; but how this could happen unless there was much less there originally than on earth is hard to understand.

For the major planets we have to consider the course of events in a cooling mass containing an excess of the lighter elements and especially of hydrogen. The condensation of the refractory constituents should take place much as for a smaller body. The principal constituents of the rocks, however—potassium, sodium, magnesium, aluminium, calcium and silicon—are not reduced from their oxides by hydrogen, and would form rocks not unlike those of the earth. But at high temperatures the oxides of iron are reduced by hydrogen. My colleague, Professor H. S. Taylor—to whom I am greatly indebted for counsel on these problems of physical chemistry—remarks that the drops of molten lava falling through a hydrogen atmosphere reproduce pretty closely the conditions of a blast furnace. We may conclude then that most of the iron would go into the core and less into the rocky shell.

After the core solidifies, the remainder of the mass will remain fluid over a wide range of temperature. Its principal elementary constituents will be hydrogen, helium, oxygen, carbon and nitrogen, with smaller quantities of the other inert gases, sulfur and the halogens.

The principal reactions which occur in such a gaseous medium at different temperatures and pressures have been carefully studied, for, in addition to their theoretical interest, they are of great practical importance in chemical industry.

When oxygen, carbon and hydrogen are considered the main reaction is

$$CO_2 + 4H_2 \rightleftarrows CH_4 + 2H_2O$$

The formation of methane is accompanied by diminution of volume: hence it will be favored by high pressure. High temperature works the other way: from the free-energy data it appears that, at 1000° C. and atmospheric pressure, the equilibrium inclines to the side of carbon dioxide, even in the presence of a large excess of hydrogen. Below 300° C. practically all the carbon should go into methane: at about 600° the amounts of the two gases should be comparable.

With hydrogen and higher hydrocarbons the tendency of the reaction is always towards methane at low temperatures. With saturated hydrocarbons, this involves no change of volume and should not be affected by pressure. Formation of methane from unsaturated hydrocarbons should be favored by high pressure. The exclusive presence of methane in the planets' atmospheres might thus have been predicted.

The formation of ammonia from its elements, in accordance with the equation

$$N_2 + 3H_2 \rightleftarrows 2NH_3$$

liberates less energy. With excess of hydrogen, and at atmospheric pressure, the amounts of nitrogen and ammonia should be equal between 200° and 300° C.; ammonia should predominate at lower temperatures and at higher pressures.

The oxides of nitrogen are endothermic and so would tend to dissociate, rather than to form.

We may now form a definite picture of the successive reactions which will occur in the atmosphere of a cooling major planet. At temperatures of about 1000° the predominant hydrogen will be mixed with steam, free nitrogen and carbon dioxide—the carbon monoxide which occurs in stellar atmospheres having long ago been completely oxidized. With falling temperature the carbon dioxide will be converted into methane before the water reaches its critical temperature and begins to condense. After most of it has been precipitated, the nitrogen will go over into ammonia. These reactions, however, will run their course at these relatively low temperatures only with appropriate activation. For the formation of methane an excellent catalyst is available in the partially reduced oxides of iron which should be present on the rocky surface exposed to hot hydrogen. These would be equally good for the ammonia, but they may be at the bottom of the sea by the time the proper temperature is reached. An adequate activation, however, would be furnished by electrical discharges—and, if terrestrial thunderstorms are any guide, these should be abundant so long as vapors arising from the hot ocean are being condensed. When the temperature has fallen to that which the earth at present enjoys, there will be an extensive atmosphere of hydrogen, mixed with the simple hydrides—methane, ammonia and water-vapor, along with any inert gases which may all along have been present, but with little or no free nitrogen or carbon dioxide. Below this will be an ocean—perhaps very deep, strongly alkaline with ammonia, and incidentally containing in solution any compounds of sulfur and the halogens which may originally have been present. The conditions in such an alkaline ocean—its action on the rocky bed, the compounds which it will hold in solution, and the deposits which it may form—would be of great interest, but are outside our present scope.

With further cooling the water will freeze, but at a temperature below 0° C. depending on the percentage of ammonia. With one part of the latter to two of water the freezing point would drop to −100° C., but it is doubtful if there is enough ammonia for this. The major planets—even Jupiter—are still colder, and the water must be thoroughly frozen out of their atmospheres, leaving only ammonia and methane. The ammonia, indeed, must be at the point of precipitation. Dunham has obtained in this way a minimum temperature for Jupiter's visible surface. The ten meters of ammonia above the surface, under the planet's surface gravity, should exert a pressure of 1.5 mm (on the familiar laboratory scale). The vapor tension of the solid (below the triple point) has this value at −107° C. At a lower temperature the observed quantity of ammonia could not exist in the atmosphere—it would partially condense itself by its own weight.

If the atmosphere consists mainly of hydrogen this limit may be lower, for the mean molecular weight is diminished, and the partial pressure of the ammonia in the same proportion. With a large excess of hydrogen the pressure may be reduced to one sixth of the previous value and the limiting temperature to −120° C.

The direct radiometric observations of Jupiter indicate a temperature of about −135°; but this determination is complicated by large and rather uncertain corrections for the absorption of infra-red radiation in the atmospheres of the earth and the planet, so that the agreement is about as good as could be expected. It is, therefore, very probable that the clouds which form Jupiter's surface are composed of minute crystals of frozen ammonia. A perfectly absorbing and radiating planet, at Jupiter's distance and heated exclusively by the sun, would have a mean temperature of −151° C. The excess in the actual temperature may be attributed partly to the fact that we observe the sunlit (and warmer) side; partly to the "greenhouse" effect of the atmosphere, which lets in the short-wave radiation from the sun much more

easily than it lets the long-waves emitted from the planet's surface out again; and partly, perhaps, to some residual internal heat in the planet. The existence of the latter is made probable by the rapid changes in the cloud-forms, which often suggest the ascent of new material from below. The variety of colors upon the surface, which range from clear white through pinks and browns almost to black, remain unexplained.

On Saturn, where the ammonia bands are fainter than on Jupiter and the surface gravity less than half as great, the limiting temperature may be 10° or 15° lower. The radiometric observations indicate about the same difference.

Uranus and Neptune, being farther from the sun, should be still colder. The ammonia should be frozen out of their atmospheres, leaving them clear to a greater depth, which may explain the extraordinary strength of the methane bands in their spectra. The methane itself must be nearly ready to condense on Neptune, despite its very low boiling point. Assuming, roughly, that Neptune has six mile-atmospheres of methane above its surface, the pressure, due to this alone, would be about 500 mm and the limiting temperature $-165°$ C. A large excess of hydrogen might reduce this to $-183°$. Solar radiation alone would maintain a mean temperature near $-220°$. Whether the difference arises from the powerful "greenhouse" effect of the methane itself, or from internal heat, can not yet be determined. It may be, however, that if the methane could once be frozen out of Neptune's atmosphere, the surface temperature would fall so much that it would stay frozen and leave the planet with an atmosphere which, apart from the inevitable Rayleigh scattering, exerted no influence upon visible light.

The problem of planetary atmospheres, so perplexing a few years ago, is now far advanced toward its solution. Toward its interpretation many of the sciences have contributed—astronomy, physics, chemistry, geology, biology and technology. No one of them alone could have resolved the difficulties. It may, therefore, be appropriate that the attention of so general a scientific gathering may have been invited for a while to it: for it truly illustrates the old motto, "In union there is strength."

SCIENTIFIC EVENTS

THE BRITISH WATER POLLUTION RESEARCH BOARD

In the annual report of the Water Pollution Research Board for the year ended June 30, 1934, issued by the Department of Scientific and Industrial Research, according to a summary in the London *Times*, reference is made to the exceptional conditions of weather during 1933 and 1934. The long spell of dry weather not only caused difficulties in the provision of ample quantities of water, but also had a serious detrimental effect on the quality of the water in rivers and streams into which sewage and trade effluents are discharged, as less water than usual was available for dilution of the discharges.

The investigations initiated by the board may be divided into four main groups dealing respectively with purification of water for public supply, methods of treatment and disposal of sewage, methods of treatment and disposal of trade effluents, and various problems of river pollution.

With regard to water for public supply, many experiments have been carried out with the object of ascertaining the effects of various factors on the treatment of water by the base-exchange process of softening. During the last two years experiments have been carried out on methods of treatment of British clays with the object of preparing base-exchange material suitable for water softening. Many samples of clays have been employed and a method of treatment has been devised whereby prepared clays have been produced with water-softening capacities greater than those of some imported materials at present in use.

Further experiments have been carried out in the laboratory on methods of treatment of the waste waters discharged from dairies and milk products factories. These effluents may seriously affect rivers and streams into which they are discharged, and may be many times as strong in polluting character as domestic sewage. The problem is of particular importance at the present time because of the expansion of the milk industry and the increase in the number of large centralized factories and milk collecting and distributing depôts. During the year many cases of serious difficulty and pollution of streams by such effluents have arisen. The experiments have indicated that there are methods whereby the effluent can be satisfactorily purified before disposal, and a stage has been reached at which the processes suggested should be tested on a large scale. The industry has been informed of the progress of the work and has been offered the opportunity of cooperating both technically and financially in the further investigations which are desirable.

Considerable progress has been made in fundamental investigations of the biology and chemistry of methods of purification of sewage.

The question has also arisen whether the amount

of material deposited and the character of the deposits in the estuary of the River Mersey and in Liverpool Bay are affected by the large quantities of sewage discharged into the estuary of adjacent towns. In response to a request from the Merseyside local authorities, the Mersey Docks and Harbor Board, and other interested bodies, a comprehensive investigation of the subject has been undertaken.

THE ANNUAL REPORT OF THE DIRECTOR OF THE FIELD MUSEUM OF NATURAL HISTORY

STILL operating on a very much curtailed budget, necessitated by depression, the Field Museum of Natural History nevertheless was able to maintain during 1934 full activity so far as services to the public are concerned, according to the annual report of Dr. Stephen C. Simms, director of the museum.

Attendance at the museum was more than 1,985,000 persons. While this was a decline of about 1,284,000 from the 3,269,390 visitors received during 1933, it was nevertheless the second highest year's attendance in the history of the museum, and the reduction from the 1933 peak was a natural expectation in view of the smaller attendance at the second year's Century of Progress Exposition. Of the visitors in 1934, only about 99,000, or approximately 5 per cent., paid the 25-cent admission fee charged on certain days; all the rest, approximately 95 per cent., either went on the days when admission is free, or belonged to classifications such as children, teachers and students, who are admitted free on all days.

The scientific expeditions of the museum had to be kept to a minimum. The Straus West African Expedition of Field Museum, sponsored by Mrs. Oscar Straus, of New York, collected zoological material in Senegal, the French Sudan, Nigeria and Angola (Portuguese West Africa). The Leon Mandel Guatemala Expedition, sponsored by Leon Mandel, of Chicago, concluded its work of making comprehensive collections of characteristic Central American fauna. Research on sites of ancient Maya civilization was conducted by an expedition jointly sponsored by the Carnegie Institution of Washington, D. C., and Field Museum. The Field Museum Archeological Expedition to the Southwest, financed by the Julius and Augusta N. Rosenwald Fund of the museum, carried on its fourth season of operations on the Lowry ruin, prehistoric Indian site in Colorado. An anthropometric survey of Kurd, Arab and Beduin populations was made by the Anthropological Expedition to the Near East sponsored by Marshall Field, of New York and Chicago. The Joint Botanical Project of the Rockefeller Foundation and Field Museum was in its fifth year of operations in Europe. Paleontological field work was conducted in Nebraska, the Bad Lands of South Dakota and Pennsylvania.

A new hall devoted to domestic animals was opened. It contains a series of sculpture in marble and bronze, one fourth life-size, by the sculptor Herbert Haseltine, of champion horses, beef and dairy animals, sheep and swine of Great Britain. The collection is a gift to the museum from Marshall Field, a member of the board of trustees. Many new habitat groups of wild animals were added to the zoological exhibits. The additions of further sculptures of types of races of mankind by Malvina Hoffman brought the series of nearly 100 figures in Chauncey Keep Memorial Hall practically to completion.

The regular lecture courses in spring and autumn, and the year-around lecture tours for adults, as well as the series of motion picture programs, extension lectures and other activities for children presented by the museum unit known as the James Nelson and Anna Louise Raymond Foundation, were continued as in other years, and were attended by approximately 240,000 persons. The N. W. Harris Public School extension, another separately endowed department of the museum, maintained its service of circulating some 1,300 traveling natural history exhibits which daily reach about 500,000 children in all the public and many private schools of Chicago.

Field Museum Press issued a number of important scientific publications for international circulation, as well as several leaflets in popular style for lay readers.

Two new members were elected to the museum's board of trustees—Joseph N. Field, of Chicago, and Leslie Wheeler, of Lake Forest, Ill. The museum suffered the loss by death of its curator of anthropology, Dr. Berthold Laufer, noted for his research in Oriental subjects. Subsequent to his death, Dr. Paul S. Martin was appointed acting curator in charge of the department.

OFFICERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A FULL account of the Pittsburgh meeting of the American Association for the Advancement of Science and of the scientific societies associated with it, edited by the permanent secretary, will be published in the issue of SCIENCE for February 1.

Officers of the association were elected as follows:

PRESIDENT

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

VICE-PRESIDENTS AND CHAIRMEN OF THE SECTIONS

Mathematics—Dr. T. H. Hildebrandt, University of Michigan.

Physics—Dr. John T. Tate, University of Minnesota.

Chemistry—Dr. Moses Gomberg, University of Michigan.

Astronomy—Dr. H. R. Morgan, U. S. Naval Observatory.

Geology and Geography—Dr. Walter E. McCourt, Washington University.

Zoological Sciences—Dr. Oscar Riddle, Station for Experimental Evolution, Carnegie Institution of Washington, Cold Spring Harbor, L. I.

Botanical Sciences—Dr. E. W. Sinnott, Columbia University.

Anthropology—Dr. N. C. Nelson, American Museum of Natural History, New York.

Psychology—Dr. Joseph Peterson, George Peabody College for Teachers, Nashville, Tenn.

Social and Economic Sciences—Dr. Shelby Harrison, Russell Sage Foundation, New York.

Historical and Philological Sciences—Dr. George Sarton, Harvard College Library.

Engineering—Dr. Harvey N. Davis, president, Stevens Institute of Technology, Hoboken, N. J.

Medical Sciences—Dr. Stanhope Bayne-Jones, Yale University Medical School.

Agriculture—Dr. H. K. Hayes, University of Minnesota.

Education—Dr. F. B. Knight, University of Iowa.

GENERAL SECRETARY

Dr. Otis W. Caldwell, professor of education and director of the Institute of School Experimentation, Teachers College, Columbia University.

MEMBERS OF THE EXECUTIVE COMMITTEE

Dr. Burton E. Livingston, director of the laboratory of plant physiology, the Johns Hopkins University.

Dr. J. McKeen Cattell, editor of SCIENCE.

MEMBERS OF THE COUNCIL

Dr. Louis B. Wilson, professor of pathology and director of the Mayo Foundation.

Dr. William F. Ogburn, professor of sociology, University of Chicago.

MEMBERS OF THE COMMITTEE ON GRANTS

Roger Adams, University of Illinois.

McKeen Cattell, Cornell University Medical College.

MEMBER OF THE FINANCE COMMITTEE

Dr. Herbert A. Gill, Washington, D. C.

TRUSTEE OF SCIENCE SERVICE

Dr. Henry B. Ward, permanent secretary of the American Association for the Advancement of Science.

MEMBER OF THE DIVISION OF FOREIGN RELATIONS OF THE NATIONAL RESEARCH COUNCIL

Dr. William A. Noyes, professor of chemistry and emeritus director of the chemical laboratory, University of Illinois.

SECTION COMMITTEEMEN

Mathematics (*A*)—E. B. Stouffer, University of Kansas.

Physics (*B*)—A. L. Hughes, Washington University.

Chemistry (*C*)—J. H. Hildebrandt, University of California.

Astronomy (*D*)—Dinsmore Alter, University of Kansas.

Geology and Geography (*E*)—Edward L. Troxell, Trinity College, Hartford, Conn.

Zoological Sciences (*F*)—Paul S. Welch, University of Michigan.

Botanical Sciences (*G*)—F. E. Denny, Boyce Thompson Institute.

Anthropology (*H*)—Truman Michelson, Smithsonian Institution, Washington, D. C.

Psychology (*I*)—John Dashiell, University of North Carolina.

Historical and Philological Sciences (*L*)—John W. Oliver, University of Pittsburgh, and M. J. Herskovits, Northwestern University.

Engineering (*M*)—C. J. Tilden, Yale University.

Medical Sciences (*N*)—Walter W. Cannon, Harvard Medical College.

Agriculture (*O*)—Emil Truog, University of Wisconsin.

Education (*Q*)—A. I. Gates, Columbia University.

RECENT DEATHS

DR. G. CARL HUBER, professor of anatomy, director of the anatomical laboratories and dean of the Graduate School of the University of Michigan, died on December 26. He was sixty-nine years old and had been a member of the faculty for forty-five years.

DR. FRANK THILLY, professor of philosophy at Cornell University since 1906 and from 1915 to 1921 dean of the College of Arts and Sciences, died on December 28, at the age of sixty-nine years. Dr. Thilly was from 1891 to 1893 fellow and instructor in logic and the history of philosophy at Cornell, resigning to become professor of philosophy at the University of Missouri. In 1904 he was called to Princeton University, where he was Stuart professor of psychology for two years, returning to Cornell in 1906.

DR. LEWIS STEPHEN PILCHER, from 1885 to 1895 professor of surgery at the New York Post-Graduate Medical School; founder and former editor of the *Annals of Surgery*, died on December 24. He was eighty-nine years old.

CAPTAIN JOSEPH E. BERNIER, the French-Canadian Arctic explorer, died on December 26. He was eighty-three years old.

DR. GEORG ELIAS MÜLLER, professor of philosophy at the University of Göttingen since 1881, died on December 27. He was eighty-four years old.

A CORRESPONDENT writes: "Professor Wilhelm His, for many years the head of the first medical clinic of the Berlin Charity Hospital, died on November 10 at the age of seventy-one years, in Brombach, where he had been living in retirement since 1932. He was the son of the well-known anatomist of the same name. The younger His is known for his discovery of the His's Bundle and for the His's Disease or Five-day Fever which made its appearance during the war."

SCIENTIFIC NOTES AND NEWS

PROFESSOR EDWARD BARTOW, head of the department of chemistry and chemical engineering in the State University of Iowa, has been elected president of the American Chemical Society for 1936. He will serve as president-elect during 1935. On January 1, Professor Roger Adams, of the University of Illinois, now president-elect, took office as president of the society, succeeding Dr. Charles L. Reese, retired chemical director of E. I. du Pont de Nemours and Company, Inc.

DR. NEVIN M. FENNEMAN, professor of geology and geography at the University of Cincinnati, was elected president of the Geological Society of America at the recent meeting at Rochester, New York.

DR. CLARENCE S. ROSS, geologist of the U. S. Geological Survey, was elected president of the Mineralogical Society of America, and Dr. Charles K. Swartz, who retired in 1931 as collegiate professor of geology at the Johns Hopkins University, was elected president of the Paleontological Society.

DR. K. F. MEYER, professor of bacteriology and director of the Hooper Foundation for Medical Research of the University of California, has been nominated for election to the presidency of the Society of American Bacteriologists.

OFFICERS of the American Society of Tropical Medicine were elected at its thirtieth annual session in San Antonio on November 14, 15 and 16 as follows: Dr. Edward B. Vedder, of the medical research laboratory of the Chemical Warfare Service, Edgewood Arsenal, *president;* Dr. Henry E. Meleney, associate professor of preventive medicine at Vanderbilt University, *president-elect;* Dr. Lewis W. Hackett, assistant director of the International Health Division of the Rockefeller Foundation, *vice-president,* and Dr. Chas. F. Craig, professor of tropical medicine and director of the department, at the School of Medicine, of Tulane University, *editor*. Dr. Alfred C. Reed, of the Pacific Institute of Tropical Medicine at the University of California, is secretary and treasurer of the society. The thirty-first annual meeting will be held in St. Louis, in November, 1935, again in conjunction with the Southern Medical Association.

THE Perkin Medal of the Society of Chemical Industry will be presented to Dr. George O. Curme, Jr., of the Carbide and Carbon Chemicals Corporation, on January 11. Among the speakers at the meeting, at which five national chemical societies will be represented, will be Dr. E. R. Weidlein, director of the Mellon Institute, Pittsburgh; Professor Marston T. Bogert, of Columbia University, past-president of the Society of Chemical Industry, will make the presentation, and Dr. Curme will deliver an address entitled "Industry's Toolmaker," in which he will give an account of his work.

THE twelfth annual American Association prize of one thousand dollars has been awarded to Dr. Vern O. Knudsen, University of California at Los Angeles, for his paper, entitled "The Absorption of Sound in Gases." This paper was delivered at a joint session of the American Physical Society and the Acoustical Society of America, meeting under Section B (Physics) of the American Association.

ON the closing day of the annual congress of the British Institute of Radiology, Sir William Bragg was presented with the Mackenzie Davidson Medal following the delivery of the fifteenth Mackenzie Davidson Memorial Lecture in which he discussed the nature of organic molecules.

Nature reports that the gold medal for 1934 of the Royal Agricultural Society of England has been awarded to Sir Arnold Theiler, formerly director of veterinary research in South Africa, for his work in veterinary pathology, which over a period of more than thirty years "has been of tremendous benefit to mankind in the Union of South Africa and to the Empire as a whole."

THE Déjerine prize of the French Society of Neurology, Paris, has been awarded for 1933 to Dr. Laruelle, of Brussels.

The British Medical Journal states that at a meeting of the French Academy of Medicine on November 6, Dr. Siredey congratulated Dr. Guéniot, of the section of surgery, on his one hundred and second birthday.

DR. ALBERT VON SZENT-GYORGYI, of the University of Szeged, Hungary, will be during February visiting lecturer of physiology at Harvard University.

DR. FREDERICK G. NOVY, professor of bacteriology and dean of the Medical School of the University of Michigan, will retire from active service at the end of the present semester. Dr. Novy has been associated with the university for forty-eight years, becoming assistant in organic chemistry in 1886. He has been professor of bacteriology since 1902 and director of the Hygienic Laboratory since 1909.

DR. THOMAS J. LEBLANC has been promoted from associate professor to professor of preventive medicine in charge of a new department of preventive medicine at the University of Cincinnati College of Medicine.

DR. KENNETH S. RICE, formerly acting head of the department of biology of the University of Maine, has

joined the staff of the department of physiology, of the College of Medicine, University of Tennessee, Memphis.

HELEN F. TUCKER, formerly assistant professor of inorganic and analytical chemistry at Russell Sage College, has been appointed assistant professor of chemistry at Skidmore College, Saratoga Springs, N. Y.

DR. MURIEL ELAINE ADAIR has been elected to a second John Lucas Walker Scholarship at the University of Cambridge. This studentship, valued at £300 a year, was founded in 1807 under the will of the late John Lucas Walker, of Trinity College, for the furtherance of original research in pathology. It is open to persons of either sex, and the student need not necessarily be a member of the university. Mrs. Adair is the wife of G. S. Adair, fellow of King's College.

DR. ERWIN E. NELSON, associate professor of pharmacology at the University of Michigan, was recently appointed principal pharmacologist in charge of the Drug Division of the Food and Drug Administration of the U. S. Department of Agriculture. Dr. Nelson had been retained previously as an occasional consultant on specific questions and as an expert witness in court cases.

E. P. POLUSHKIN, formerly instructor in metallography at the School of Mines, Columbia University, has been appointed associate metallurgist, with particular reference to research and development, with Louis Pitkin, Incorporated, New York, N. Y.

N. K. CHANEY, assistant director of research of the National Carbon Company, Cleveland, Ohio, a member of the staff for eleven years, has resigned to accept a similar position with the United Gas Improvement Company, Philadelphia.

W. S. MANSFIELD, Emmanuel College, has been appointed director of the University Farm of the University of Cambridge.

T. H. C. TAYLOR, entomologist of the Coconut Committee, Fiji, has been appointed assistant entomologist to the Agricultural Department, Uganda.

THE Committee on Scientific Research of the American Medical Association, of which Dr. Ludvig Hektoen is chairman, has granted a sum of money to the Surgical Research Laboratory of the Stanford University School of Medicine for the prosecution of Dr. Frederick Fender's work on the "Effect of Prolonged Electrical Stimulation of Selected Components of the Nervous System in Animals." The committee has also renewed a grant to Dr. John Guttman, assistant professor of otology at the Columbia University Post-Graduate Medical School, for his work on the electric potential produced by sound in the auditory apparatus.

DR. MAURICE N. RICHTER, assistant professor of pathology at Columbia University, is visiting Puerto Rico, where he will give a series of clinico-pathological conferences before the faculty and hospital staff of the School of Tropical Medicine. He will also assist in the work of the department of pathology.

DR. L. H. BAEKELAND, honorary professor of chemical engineering, lectured recently at Columbia University on "Detriments and Stimulants in the Chemical Industry."

DR. WILLIAM E. GALLIE, professor of surgery, University of Toronto Faculty of Medicine, will deliver the 1935 Shattuck Lecture of the Massachusetts Medical Society.

SIR DANIEL HALL, chief scientific adviser to the British Ministry of Agriculture, has been appointed Rede lecturer for 1935. The lecture will be delivered on March 4.

MERVYN O'GORMAN read a paper entitled "Bringing Science into the Road Traffic Problem" before the British Science Guild at the Royal Society of Arts on December 19.

THE American Institute's Christmas Lectures on "The Frontiers of Science" were given in the auditorium of the American Museum of Natural History, New York, on December 26 and 27. Each lecture was attended by about fifteen hundred young people. The lectures were arranged by the institute in recognition of the work in science done by boys and girls in their after school hours. Dr. Harold C. Urey, of Columbia University, gave the first lecture on December 26 on "Heavy Water." He was followed on the same day by Dr. Robert Chambers, research professor of biology at the Washington Square College of New York University. His lecture was entitled "Glimpses into the Mechanics of Cell Life." Jeannette Piccard, pilot and co-explorer with her husband, Dr. Jean Piccard, on their recent trip into the stratosphere, was the first speaker on December 27. Mrs. Piccard explained the scientific significance of their flight in the study of cosmic rays. She was followed by Russell Owen, correspondent of *The New York Times* on the first Byrd Expedition to the South Pole. Mr. Owen spoke on "Exploring the Antarctic." Mr. Robert T. Pollock, trustee of the American Institute, and Dr. Roy Chapman Andrews, vice-director of the American Museum of Natural History in charge of exploration, introduced the speakers. Those who attended the lectures were members of the American Institute's Junior Science Clubs. In addition, honor

students in science were invited from high schools in the suburbs surrounding New York. These students were selected, in each case, by their high-school principal because of the excellence of their work in science. The lectures are patterned on the Christmas Week Lectures held for young people for over a century by the Royal Institution of London.

ACCORDING to *Nature*, the twenty-fifth annual exhibition of scientific instruments and apparatus arranged by the British Physical Society was held on January 1, 2 and 3 at the Imperial College of Science and Technology, London. The leading manufacturers of scientific instruments exhibited their latest products in the trade section. The Research and Experimental Section contained contributions from most of the important research laboratories in Great Britain, and there was a special subsection devoted to experiments of educational interest. In addition the work submitted for the craftsmanship competition by apprentices and learners was on view. Discourses delivered during the meeting were: January 1, Dr. B. Wheeler Robinson, "The Architecture of Molecules"; January 2, Dr. C. V. Drysdale, "The Problem of Ether Drift"; January 3, Dr. H. Spencer Jones, "Giant Telescopes."

THE post-doctorate fellowships in the biological sciences (zoology, botany, anthropology, psychology, agriculture and forestry), available through the National Research Council for the academic year 1935–1936, will be awarded by the Board of National Research Fellowships in the Biological Sciences at a meeting which is to be held the latter part of March. Applications should be filed with the office of the board by February 1. Appointments may be made prior to the conferring of the doctor's degree, to be effective upon the receipt of the degree within six months. Application blanks and statement of conditions will be furnished upon request by the secretary of the Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

EIGHT more of the thirty-three institutions selected four years ago by Calvin Coolidge, Alfred E. Smith and Julius Rosenwald as the proper beneficiaries of the estate of Conrad Hubert, who died in 1928, soon will receive a total amount of $1,000,000. The accounting, covering a period from October 4, 1930, to October 1, 1934, shows that payments of $4,600,000 have been made as previously announced to fifteen institutions also chosen by the committee of three which disposed of the $6,000,000 left for that purpose by Mr. Hubert, who came to this country from Russia as a penniless boy and made a fortune with his invention of the flashlight. The contemplated payments follow: University of Chicago, $250,000; Henry Street Settlement, $100,000; American Foundation for the Blind, Inc., $100,000; Beth Israel Hospital Association, $200,000; Howard University, Washington, $200,000; William and Mary College, Catholic University of America and University of Virginia, $50,000 each.

THE late Dr. Roland B. Dixon, of Harvard University, created in his will trust funds of about $25,000 for the benefit of Harvard University. His books on American archeology and ethnology are left to the Harvard University Library and the Peabody Museum library and a number of his personal effects and other books are bequeathed to the president and fellows of Harvard College for use in the museum. $1,000 is bequeathed to the library of the town of Harvard. From the residue of the estate two trust funds are established at the university. One is to be known as the Roland B. Dixon Fund and the other as the Lewis S. Dixon Fund. The income of these funds is to be used for the purchase of books on anthropology and archeology and particularly of books concerning the American Indians.

AN endowment of $10,000 for an annual award in the interest of the progress of aviation has been provided by Dr. Sylvanus A. Reed, of New York. Fellows of the Institute of the Aeronautical Sciences will select the recipient of the award who will receive a cash prize of $250 and a certificate of merit. The award will be for "the greatest advance in the aeronautical sciences resulting from experimental or theoretical research, the beneficial effect of which on the development of practical aeronautics is apparent." The first award will be made at the annual meeting of the institute at Columbia University on January 30.

JOHN D. ROCKEFELLER, JR., has given to the Rockefeller Institute for Medical Research the block of land bounded by York and First Avenues, Sixty-seventh and Sixty-eighth Streets. Mr. Rockefeller is reported to have assembled the land over a long period originally, it is said, with the intention of using it for the Memorial Hospital, formerly the New York Cancer Hospital.

A COMMITTEE from the medical faculty of the University of Virginia has been appointed to work with architects in drawing detailed plans for the new wing of the University of Virginia Hospital which will be made possible by a recent Public Works Administration grant of $208,500. Dr. James Carroll Flippin, dean of medicine; Dr. Robert V. Funston, professor of orthopedic surgery; Dr. John H. Neff, professor of urology; Dr. Tiffany John Williams, professor of obstetrics and gynecology, and Dr. Carlisle S. Lentz, superintendent of the hospital, form a committee of

the faculty in charge of the construction of the new wing.

THROUGH the help of the Yellowstone Library and Museum Association, the Naturalist Department of Yellowstone National Park has made progress during the past year. The library which has now been catalogued contains 1,442 bound volumes, 1,862 pamphlets and bulletins, and a large number of magazines and periodicals. Gifts received during the year include original sketches made by Dr. W. H. Holmes and Mr. Henry Elliott, of the Hayden Surveys; an unpublished manuscript by Captain G. C. Doane detailing a trip through Yeulowstone and the Grand Tetons in 1876–1877; also a collection of fossils made by the early members of the Hayden and Hague surveys in Yellowstone Park, loaned by the U. S. National Museum to the Yellowstone Museums.

DISCUSSION

REPORT OF THE SCIENCE ADVISORY BOARD

EARLY in the week of December 9 the president released the report of the Science Advisory Board. About fifty preliminary copies of this report were released to the press. The bound copies will be ready for rather wide distribution to libraries, Congress, government officers, members of the National Academy of Sciences and others during the first week in January.

Quite unexpectedly a large section of the press featured practically the only aspect of the activities of the Science Advisory Board which has not been at least partially successful, and an aspect which was included in the report, merely as part of the historic record of the activities of the board. I therefore feel that a brief explanation may be of interest to supplement the official news release from Science Service which has already appeared in SCIENCE.

The publicity referred to centered around the proposal of a "Recovery Program of Science Progress" which had been presented to the Public Works Administrator on September 15, 1933, for his consideration as a means for providing useful employment to the large numbers of scientists who at that time were being dropped by government bureaus, industrial research laboratories and universities. It was definitely a proposal for emergency employment, designed to enable these scientists to find work of a type in which they could make valuable contributions to problems of social value.

It was proposed to expend a total fund of $16,000,000 on a tapering-off basis over a period of six years, on advice of a committee of scientists to be set up under the National Academy of Sciences and the National Research Council. No program of work was submitted since it was felt that the development of such a program should be one of the functions of the proposed advisory committee. There were, however, submitted a dozen or so examples of scientific or engineering problems of unquestioned social value and promise of successful solution, which were intended merely to illustrate the kinds of things which needed to be done and which might be submitted to the advisory committee and the Public Works Administrator if the plan were authorized.

This proposal was sponsored by some thirty-five executive officers of the national engineering and scientific societies, including the Science Advisory Board. It was submitted to the Public Works Administrator in person, by Dr. Alfred D. Flinn, director of the Engineering Foundation, and myself. After a considerable discussion, Mr. Ickes said that he was 99 per cent. convinced that something of the sort should be done, but that there was unfortunately no provision under the law whereby public works funds could be expended for research but only for construction.

The matter was dropped at that point and was included in the report of the Science Advisory Board only as an historic document because the board assisted in the formulation of the proposal.

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BEHAVIOR PATTERN AND BEHAVIOR MORPHOLOGY

THE word *Morphologie* when first coined by Goethe was used in relation to physical structure. The term still carries physical connotations. But the concepts of morphology can be extended to the phenomena of behavior. Morphology is the science of form. Form is the shape of anything, as distinguished from the substance of that thing. Behavior has shape, temporal and spatial. It is never amorphous. It has pattern in the momentary phase; it has pattern in the series of moments that make an episode; it has pattern when regarded in the full perspective of the life cycle.

The form characteristics of behavior pattern can be investigated in their own scientific right. A morphological approach concerns itself chiefly with problems of form—the description and measurement of specific forms; the systematic study of the topographical relations and the correlation of these forms, their ontogenetic progression and involution, their comparative features among individuals and among species. Any psychological theory which is so ab-

stractly dynamic that it overlooks or slights basic problems of form-production is at least incomplete. The individual is a *morphon* as well as a *bion!*

In the field of developmental psychology it is peculiarly important that the total behavior complex should be envisaged and explored from the standpoint of morpho-genesis. This complex lacks corporeal tangibility; but it does not lack form characteristics. The action systems of embryo, fetus and infant undergo progressive changes of pattern which are so consistent that we may be certain that these changes are governed by mechanisms of form regulation comparable to those which are being established by the science of embryology. Fundamentally, no doubt, the growth of tissues, of organs and of behavior is patterned by identical laws of developmental morphology. It may even prove that certain principles in the physiology of development such as polarity, symmetry, organization center and induction influences will find a modified status in the concepts of psycho-genesis.

The term *behavior pattern* is confessedly protean, but it can not be misleading if the aspect of form consistently receives major emphasis. A pattern of behavior is a configured response which can be concretely described in terms of a given situation. A *behavior item* is a feature or a component of a pattern, ascertainable by analysis. Neither pattern nor item has status as a circumscribed entity. A pattern always has context, and this context if analyzed can in turn be reduced to constituent patterns. But since contexts also have contexts, it follows perhaps that the only pattern which has complete integral status is the organismic pattern which is the individual himself.

Behavior patterns therefore range from minute manifestations, like the wink of an eyelid and the wag of a finger, to the complicated sequences of problem solving and of personality response. A durable task of genetic psychology is to find among the multitudinous patterns of infancy, similarities, modalities and growth-trends which are so fundamental that they give token of the adult, who is to be. This, I would hold, is first of all a morphological or a morphographic task.

A complete description of any behavior pattern would have to take into account the total stimulus pattern as interpreted by Klüver. But coordinate and final consideration must always be given to the form-producing and the form-limiting factors which are resident in the growing organism. Environmental factors inflect, but they do not generate the progressions of development. The maturational matrix is the morphogenetic substratum in which the behavior mechanisms are organized. This matrix is not a diffuse, homogeneous colloidal essence of some kind, but a structured reality which must be scientifically considered in morphological terms.

Now, with this prelude, we may examine a convenient and very suggestive series of behavior patterns, namely those that pertain to the infant's index finger. Let us see whether this finger points to any conclusions.

As early as the eighteenth prenatal week the fetal index finger is capable of spontaneous, undirected movement. But the index finger of the newborn infant remains relatively inactive and is crooked in a clenched fist night and day. In the Yale normative survey the hand posturing of scores of infants was observed while they lay basking in a supine position. The observations, confirmed by cinema records, show that the hands remained predominantly closed in over half of the infants at 4, 6, 8 and 12 weeks of age. But at 20 weeks the hand is predominantly open and the index finger, along with its associates, asserts itself in an interesting pattern of activity, mutual fingering. In this fingering the digits begin to define their separate identities, both as agents and as recipients of impressions. In prehension and manipulation, however, the digits function conjointly, the ulnar digits, as shown by Halverson, taking the lead in functional differentiation.

This retardation in the behavior patterning of the two radial digits, thumb and index, is unquestionably a morphological phenomenon. It is correlated with the very topographic anatomy of these ultimately opposable digits; and is bound up by ramification with far-reaching postural reorientations which involve the wrist, the forearm, the upper arm, the shoulder, eyes and head. The progressive predomination and specialization of the index finger is essentially a process of postural moulding. The inherent morphogenetic character of this process is strikingly displayed in the development of the prehensory reactions to a 7 mm pellet placed before the seated infant at advancing age levels:

At 24 weeks the infant contacts the pellet with pronate hand, in a pawlike manner, with no finger adjustments.

At 28 weeks he flexes his fingers upon the pellet.

At 32 weeks he grasps it by a simultaneous raking flexion.

At 36 weeks he grasps it between thumb and index.

At 40 weeks he approaches and contacts the pellet with extended index. He pokes and pries with his index.

This poking projection of the index is a pattern characteristic so well defined that at 40 weeks it is almost as plain as the nose on his face. It is a new form of behavior, and like the profile of his nose, it is an intrinsic morphogenetic product.

The developmental basis of this poking proclivity

came to very pretty expression in our study of Twins T and C by the method of co-twin control (Gesell and Thompson). Detailed comparative observations of the behavior characteristics of these twins were made. A thoroughgoing identity was established prior to the experimental investigation. On one examination both twins made a raking approach on the pellet, with simultaneous flexion of the digits. Two weeks later under the same conditions each twin approached each pellet with projected index and each twin placed the tip of the index on the pellet. These remarkably similar changes in prehensory pattern occurred contemporaneously, without specific training or imitation.

The preeminence of the index (and thumb) can scarcely be set down as an act of skill acquired primarily by learning. The learning process has no architectonic mechanism which can account for such a topographic alteration of behavior pattern. Training and experience perfect and inflect, but always in specific and immediate confines. They do not engender the basic reconfigurations of behavior. Else, why does not our infant become an expert raker of pellets by gross manual approach, instead of a temporarily ineffectual plucker by refined, digital approach?

It is of crucial significance that the poking propensity asserts itself not only in the presence of small objects like the pellet. The poking is not the consequence of a unique stimulus pattern. The infant pokes in the presence of the cube, the bottle and the bell, as well as the pellet. He may poke in the presence of the extensive, flat-table top. The infant you saw on the screen[1] displayed specialized mobility and extension of the index finger, even when at 40 weeks he stood, eyes front, in his pen outdoors, and raised his free hand toward the circumambient sky. For a brief interval the index pointed heavenward. This behavior denotes the urgency and form-producing character of the internal stimuli which prompt him to poke and pry so inveterately at about 40 weeks of age. The index finger then becomes in fact the *fore* finger.

This poking, however, does not become stereotyped. It never is stereotyped in the normal infant. It begins somewhat sporadically and manifests itself sketchily. Early poking tends to be vague and fugitive; it may involve the thumb and medius; but steadily it defines. It becomes more prolonged; it becomes recurrent; it becomes more penetrating. Interestingly enough for a period the infant merely pokes near or at a hole large enough to admit his index (for example, the half-inch hole in the vertical side of the performance box); only at a later age does he thrust his finger well into the hole. He passes through a transitional period in which both digitally and probably perceptively he fails to penetrate into the third dimensional interior of things. But in due time he probes. His penetration becomes increasingly exploratory and exploitive. In the cinema infant this probing was associated with a mechanical kind of inquisitiveness which has been displayed in numerous life situations and already strongly indicates some form of mechanical aptitude.

New patterns differentiate with maturity, but they never completely individuate; rather, they articulate by ingrowth with concurrent patterns. While they are thus combining, yet newer patterns are differentiating and these in turn will be assimilated to the consolidating total action system. That total action system is an architectured entity, which can be adequately described only in morphological terms. It is the behavioral embodiment of the individual and his constitutional characteristics. Through it the individual as well as the species maintains identity.

The poking propensity and the poking pattern therefore constitute a well-defined example of individuation, a selective specialization of a minor member to subserve the developmental trends or needs of the organism. But that individuation is never complete or segregated, it is always partial and by extensive ramification it remains accessory to a fundamental unity of response.

In the progressive individuations and elaborations which are so palpably, almost naively, exhibited in the behavior patterns of the human fore finger, we have, I believe, a true image of the developmental mechanics of the higher mental processes. Now I do not wish to hang the whole world (and all its psychology) on the infant's extended index, but I would suggest that even in the intellectual spheres of adult invention we are dealing in essence with comparable morphogenetic phenomena. Our mechanistic assumption is that attention in infant and in man is primarily a function of pattern morphology. Acts of attention are dynamic or kinetic manifestations of patterned structure. They have a morphological status. All behavior patterns are therefore subject to morphological investigation.

If this approach is first of all descriptive, well and good. There is no royal road, even in psychology, to an understanding of the structuralization of human behavior. There has been no royal road to the science of human anatomy. We must be prepared to study the phenomena of human behavior with the same minute interest in structured form which the

[1] Prior to the paper, a talking film was shown: "The Growth of Infant Behavior: Later Stages." Yale Films of Child Development (Sound film No. 3, 1934). Erpi Picture Consultants, Inc., New York. See also Gesell, A. *et al.*, "An Atlas of Infant Behavior," Vol. I, pp. 402 *ff*. Yale University Press, New Haven, 1934.

disciplines of embryology and anatomy demand. The way is long and tedious, but the scientific footing is solid.

ARNOLD GESELL,
Director

THE YALE CLINIC OF
CHILD DEVELOPMENT

THE ORIGIN OF NATURAL OIL

THE writer of this article is compelled to adhere to his view expressed in SCIENCE of September 7, and questioned by Professor J. M. Macfarlane in the issue for November 23. The reasons are to be found in chemical and geochemical considerations. The specialist in the field of bituminous coal, natural asphalt and oil is struck with the relation of these substances. They consist of aliphatic, semi-aromatic and aromatic compounds. The presence of bituminous coal and oil in the same localities, but in different strata, for instance, near Pittsburgh, forces one to the point of view that both substances were formed from the same original material. If this point of view *and* the fish theory are correct, the origin of bituminous coal and oil would have to be traced back to dead fish. Probably few adherents will be found for such a theory.

The chemical world to-day rejects almost entirely the fish theory. Investigations by P. D. Trask and C. C. Wu[1] have shown that on distillation of samples of sea and lake water muds, which probably contain the remainder of dead fish, oil-like substances can scarcely be obtained. The quantity of oil received therefrom was exceedingly small.

Investigations have shown that under geochemical conditions the teeth and bones of fish remain almost intact. In rocks containing oil fewer inorganic relics of fish are found than undamaged parts of cellulose and wood.

The so-called catastrophe theory has been invented to save the fish theory. The entrance of fresh water into sea water or sea water into fresh water is supposed to have led to the death of enormous quantities of fish. Professor Macfarlane believes volcanic and seismic causes are responsible for this. It is difficult to explain from such a point of view the presence of oil in different strata above each other. Such would mean that catastrophes occurred at the same place at several different times.

Carbohydrates are produced by nature in the greatest degree; probably even more so in earlier periods. The quantity of fish compared to this is small. The presence of enormous quantities of oil in the interior of the earth is therefore contrary to the fish theory. It is more than probable that the savings buried by nature in the form of coal and oil in the earth originate principally in the enormous quantities of carbohydrates and carbohydrate-humic acids transformed therefrom (not lignin-humic acids) and very little, if any at all from fish.

The question of the origin of oil and bituminous coal may be clarified only by experiments and observation of thermo-dynamic, geological and geochemical conditions. The carrying out of experiments should take place under geochemical conditions. In this respect, the writer of this article has to criticize the otherwise valuable experiments carried out by Warren and Storer.[2] Warren and Storer decomposed at "red hot heat" the lime soap which was produced on saponification of fish oil with strong excess of lime. All those who have been engaged with research work on the origin of oil know that neither the action of strong hydrate of lime nor such high temperatures were possible during the formation of oil. At the low temperatures which must be considered here, the lime soap would have to be stable. In any case, it would not lead to the formation of aromatics, such as has been observed in crude oil. From a thermodynamic view-point, the transformation of aliphatic hydrocarbons formed from aliphatic acids into ring hydrocarbons is not possible at lower temperatures. The temperatures required for such transformation are above the temperature for the formation of crude oil, which certainly has not gone beyond 300° C. One can find derivatives of chlorophyll in all crude oils and asphalts. These substances are completely destroyed at temperatures above 300°.

For the formation of aromatic compounds, therefore, other reactions must be responsible. Carbohydrates may be transformed at comparatively low temperatures into semi-aromatics and aromatics (phenols and phenolcarboxylic acids). By such reactions the presence of aromatics and naphthenes in crude oil is not difficult to explain.

On the basis of his own experiments and because of thermodynamic, geological and geochemical facts, which are contrary to the fish theory, the writer of this article can not adhere to the truth of the aphorism that "fish is the source of petroleum." His experimental work and that of his collaborators in this regard will be published elsewhere.

E. BERL

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[1] *Bull. Am. Ass. Petrol. Geol.*, No. 11, 1928, and 1451, 1930.

[2] "Amer. Acad. Arts and Sc. Memoirs," 82, 9, page 177, 1867.

LUNAR RINGS

ON the evening of November 22, 1934, San Franciscans were treated to a display of spectral rings about the moon. It was first noticed by us from the steps of the Academy of Sciences at 10 P. M.,

but residents had been observing it for an hour or more. The moon was full and high overhead. Fleecy streaks of cloud, commonly termed "high fog," much too thin to obscure the disk, drifted slowly across; these seemed to be the cause of the unusual phenomenon. When we first saw it there was an inner circle, about six moon-diameters, bright, opalescent white, followed by the spectral rings from red to violet. The total diameter of the violet ring was about 12 moon diameters. Each color was sharply separated from its neighbors and the whole formed a magnificent and brilliant exhibit of the spectrum. The intensity and purity of the colors seemed to be much more pronounced than is usually seen in solar rainbows.

Points of visibility were somewhat localized. On Geary Street, five blocks away, the rings were gone and the moon was surrounded only by the opalescent disk, fading gradually outwardly. A few minutes later, at the academy, the spectral band was even more brilliant and sharply defined than when first observed, due apparently to its having shrunk to about half its former diameter. Six blocks away a few minutes later it had disappeared.

The variation in size was doubtless the result of the difference in elevation of the cloud. A slight tendency to become oval in shape was noticed occasionally, and this was probably also caused by variable thickness and elevation of the refractive stratum.

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SCIENTIFIC BOOKS

THE STORY OF A MIND

Franklin Paine Mall, The Story of a Mind. By FLORENCE RENA SABIN, M.D., Member of the Rockefeller Institute for Medical Research. The Johns Hopkins Press, pp. i–xiii, 1–342. $2.75.

HERE is the fascinating story of the life and work of one of the outstanding figures in the promotion of research in anatomy and embryology and in the reorganization of medical education in the United States. From a farm in Iowa and from a village school, Franklin Paine Mall, of German blood from both parents, went to the Medical Department of the University of Michigan in 1880 and in 1883, at the age of 26, was graduated with the degree of M.D. Stimulated by an inner drive for more knowledge he went to Germany without any very definite plan; but, with the thought that he wanted to know more about ophthalmology, he spent the academic year of 1883–84 at Heidelberg University and at the end of that year, realizing that his interests were chiefly in anatomy and embryology, he went to Leipzig and sought and obtained the privilege of working under the foremost authority in the world on those subjects, Wilhelm His. Here he learned the latest methods of research in embryology and, still more important, the value of exact methods in scientific research. A research topic was assigned him and he was encouraged to work independently, and the independence and thoroughness of his work were demonstrated by the fact that in this, his first research, he reached conclusions at variance with those of his revered professor, who subsequently acknowledged his own mistake and for the remainder of his life remained a devoted friend of Mall.

A third year in Germany he spent in the laboratory of the distinguished physiologist, Carl Ludwig, in Leipzig, and it is no exaggeration to say that Ludwig then and ever after treated him as a beloved son. He not only suggested an important problem of research and gave constant encouragement and frequent advice, but when the results of this and of later researches were submitted to him for publication, he edited them and even had the illustrations redrawn—and all with a delicacy of suggestion and a pride in the work of his young friend which was certainly most unusual and which indicated that he recognized in Mall a person of extraordinary ability and promise. When Mall expressed his great obligations and asked how he could ever repay them, he was told merely, "Pass it on!"

This ideal association with Ludwig was probably the most potent factor in shaping Mall's career, and in after years his aid and encouragement to those who did research work in his laboratory, and the love and admiration which they had for him, are evidences that he followed Ludwig's admonition to "pass it on."

On his return to the United States, Mall sought and obtained a fellowship at the Johns Hopkins University under Dr. Welch, whom he had met in Ludwig's laboratory and who ever after remained his great friend and admirer. This fellowship in pathology he held from 1886 to 1889. From 1889 to 1892 he was adjunct professor of anatomy in Clark University, and on the organization of the new University of Chicago he joined or rather led the migration from Clark to Chicago, where for a single year 1892–93, he was professor of anatomy in the Division of the Biological Sciences. He then yielded to the persuasions of Dr. Welch to accept the chair of anatomy in the newly organized Department of Medicine at the Johns Hopkins University, and this position he held until his death in 1917.

This bare outline of Dr. Mall's university connec-

tions gives no hint of the importance and thoroughness of his research work, which was published in more than one hundred monographs and contributions, nor of his great service in training dozens of the leading anatomists and embryologists of this country, nor of the leading part he took in the establishment of research journals, nor of his unceasing labors for the reorganization of medical education in this country. All this and much more is told with a wealth of detail and a great measure of admiration and affection by one of his former students and associates, Dr. Florence Sabin, in the book under review. This volume is not merely "the story of a mind," as the sub-title phrases it, but it is also the story of an era in medical science and education—the story of the transition of many medical schools in this country from the status of trade schools, conducted in many instances for the profit of proprietors and therefore with little or no laboratory facilities and with no regard to research, to the full stature of university departments for graduate study. In this transitional era the Johns Hopkins University, established in 1876, and its Medical School, fully organized in 1893, took a leading part, and probably no member of its staff was more influential in bringing about this transformation than Dr. Mall. His own standing as an investigator, his high ideals for medical education and especially his far-sighted planning accomplished more in the reform of medical education in America than is generally recognized, for he worked quietly and often through others who received the credit for what he had planned and started.

His method of teaching was almost completely different from that usually practised. Partly because he was not himself a public lecturer and partly because of his own experience in the laboratories of His and Ludwig, he taught by the inductive laboratory method, assigning problems and materials and leaving students to do the work. This was the method of His and Ludwig, of von Baer and Louis Agassiz, and in the form of "autonomous courses" it has of late begun to displace didactic lectures in many colleges and universities.

The important part which Mall took in the establishment of the *American Journal of Anatomy* and the *Anatomical Record,* as well as his last great work in bringing about the establishment in Baltimore of the Department of Embryology of the Carnegie Institution of Washington is described in this book. Also his leadership in the campaign for full-time clinical professors in medical schools is outlined, and here, for the first and only time in this book, Dr. Sabin indicates "a limitation in Mall's vision—that he underestimated the amount of technical skill actually in possession of the medical profession and the time necessary to acquire it." And this suggests that in general the book is written from the standpoint of a devoted follower of Mall rather than of an impartial judge. In particular the contrast in medical science and education before and after Mall is over-emphasized, as for example when it is said that his "program, contrasted with the ones which preceded it, is like a breath of fresh air and reminds one of the awakening of Rip van Winkle in a new era" (p. 225). And when it is stated that "to Newall (sic) Martin belongs the credit for starting modern physiological research in this country" (p. 27) one should recall some of the eminent physiologists who were Martin's predecessors or contemporaries. Other cases of such over-emphasis are evident throughout the book. There can be no question as to the great stimulus given to medical science and education by the Johns Hopkins University and by Dr. Mall, but there were other men and institutions in the forefront of this advance; on the whole, however, this is a faithful account of the great part taken by Mall in this advance.

It may seem ungracious to call attention to a number of errors, most of them trivial, but in the interest of accuracy the following errata should be noted: on page 6 the date 1885 should be 1855; everywhere (pp. 13, 14, 15, 16, 197) the name of the founder of the first medical school in America is given as "Shippan" instead of Shippen. Among those members of the faculty of Clark University who migrated to Chicago in 1892 Bolza is erroneously assigned to chemistry instead of mathematics while Nef, Watase and Wheeler are not mentioned and Lillie appears as "Lilly" (p. 88). On page 190 Miall should be substituted for "Mall" and on page 214 Linton for "Linten." Among the journals in which Joseph Leidy is said to have published his researches is listed the *Proceedings of the National Academy of Sciences,* which was not established until eighteen years after Leidy's death; evidently the *Proceedings of the Academy of National Sciences of Philadelphia* is intended. The statement on page 236 that "scientific journals were new to this country when the *Anatomical Journal* was started" is either a "slam" at the several reputable journals that had long been in the field or it is an oversight.

No doubt these and other minor errors are "slips" which will be corrected in any future edition. On the whole, this book is an inspiring account of the life, scientific work and educational activities of an extraordinarily able and forceful leader whose significant work remains after him, although his quiet and retiring personality has caused him to remain relatively unknown.

E. G. Conklin

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RECENT ZOOLOGICAL TEXT-BOOKS

DURING the latter part of 1933 and the whole of the year 1934 six new works have come to the reviewer's desk. Brief summaries of these follow.

The zoological text-books which have come from the presses of various publishers in the United States during the past few years are of three types, with various degrees of intergradation: (1) There are original works which have been carefully prepared by thoughtful, competent and alert professional men of high standing (Curtis and Guthrie; Shull, Larue and Ruthven; Guyer; Woodruff; etc.). These to some degree represent the labors of those who love science and students, and who have ideas and ideals about how things should be done. They often present new points of view and contain original illustrations. The statements which students are to read are carefully considered, critical and "scientific." One may not approve of an author's plan of treatment or of some of the opinions expressed, but such works must be treated with respect. Some of these books raise standards of teaching and thinking, as well as give information. (2) There is another class of works which are opportunistic compilations by those who write books to sell. They seldom contain original figures or ideas. They are usually encyclopedic rehashes which will be useful to a great body of not-too-well-trained, time-serving teachers. They sell because they are mediocre, conservative or perhaps even a little backward in their outlook. They perpetuate old dogmas and poor figures, which every zoologist knows only too well. Students get no ideas from such books. (3) There is unfortunately another group of books which perhaps never should have been written or published. They are the works of poor writers and perhaps even ignorant, incompetent, narrow-minded or bigoted zoologists. Students who try to use these books are often confused and worried. The writers of such books continually attempt to intrigue their readers to agree with them by the frequent use of "we" and "our." They often refer loosely and uncritically to the body, the animal, forms, higher, lower, etc. They are unprogressive because they get their own information from other text-books, and not from new, inspiring, original sources.

A glossary seems to be a rock on which many authors founder. Many attempts to define terms appear, in the hands of zoological text-book writers, to result in statements which give students a very limited or distorted view. Perhaps it may be better for writers to omit glossaries and depend instead on a good dictionary which is made readily accessible to students in a laboratory or library.

The appearance of a text-book of general science for college students raises the old question of the content of beginning courses. Shall such courses be broadly informative or give technical training in methods of scientific thought and procedure? Shall students be taught the interesting and inspiring generalizations which have resulted from zoological or botanical study without knowing about animals or plants as such? Shall the backbone of a course be general principles, types, natural history, systematics or what? Shall teachers give students what they would most like to know and what may be most useful as equipmnet for an educated man in modern society, or shall teachers train students to be real scientists in a small way? The University of Chicago now requires all students to take four broad informational courses during the first two years. This is avowedly an attempt to give students a broad point of view rather than a technical limited one. Schiller[1] says:

> The interest of the professor is to become unassailable, and so more authoritative. He achieves this by becoming more technical. For the more technical he gets, the fewer can comprehend him; the fewer are competent to criticize him, the more of an oracle he becomes. If therefore he wishes for an easy life of undisturbed academic leisure, the more he will indulge his natural tendency to become more technical as his knowledge grows, the more he will turn away from those aspects of his subject which have any practical or human interest. He will wrap himself in technical jargon and become as nearly as possible unintelligible.

The teacher is always in a dilemma. Shall he try to give students a real view of the inwardness of the subject he has spent his life in mastering or shall he artfully and tactfully select the essential things from his field of learning which will enable his students to live better lives? There is only one Huxley in each generation. A small man who attempts to write a popular text-book which is not technical and critical may do nothing but present superficial, sentimental slush. It is better to be technical than silly. The writing of a well-balanced, thoroughly scientific and interesting book which is suited to the needs of students requires a rare degree of knowledge and judgment.

Probably the scientific text-books of the future will be less technical. The increasing costs of laboratory instruction on a large scale and the continual failure of technically informed college graduates to take up the ordinary duties of life without retraining themselves make educational administrators strong advocates of general informational courses. The professional scientist hates superficiality and loose thinking, but loves accuracy and truth. He therefore fears "general" courses. Yet common sense indicates

[1] F. C. S. Schiller, "Tantalus." N. Y. vi + 66. 1924.

that he must be less technical. If scientist-teachers will seriously consider this problem they can probably show a little more human interest without sacrificing scientific spirit.

An Introductory Course in Science for Colleges. By FRANK COVERT JEAN, EZRA CLARENCE HARRAH, FRED LOUIS HERRMAN and SAMUEL RALPH POWERS. *I. Man and the Nature of his Physical Universe.* x + 524 pp. *II. Man and the Nature of his Biological World.* Ginn and Company, New York. 1934. $2.20, $2.40. This two-volume work is intended for a broad, cultural course in science. The first volume deals with astronomy; matter and energy; mechanics, electricity, aeronautics and inventions; meteorology and geology. The second begins with a discussion of protoplasm and then considers the adaptations of plants and animals for life, metabolism, evolution, ecology, heredity, man's place in nature, nutrition, hormones, public health, archeology, anthropology and sociology. Each volume has a rather limited glossary at the end. In general the work is well written, interesting and at times inspiring. Good taste is used in the selection of material which students will understand. Though the treatment is often more or less popular, as it must be because such a wide range is covered, it is thoroughly scientific.

Laboratory Outlines for Animal Biology. By MICHAEL F. GUYER and HALCYON W. HELLBAUM. xiv + 240 pp. Harper and Brothers, New York. 1933. $1.50. The first part of this manual deals with frogs in detail and the second with other representative types of animals. The work is presented as 72 exercises for two-hour laboratory periods. Though the treatment is largely descriptive, suggestive questions are often asked, and a list of topics for discussion is found at the end of each exercise. There are also some comparative tables to be filled in and drawings to be labeled. Blank pages for drawings and notes are interpolated.

General Zoology. By FREDERICK H. KRECKER. xi + 634 pp. Henry Holt and Company, New York. 1934. $3.50. This book attempts to present zoology for those who desire a liberal education, rather than training for specialization. It begins with a section called "A Typical Animal," which "deals with physiological and morphological principles applicable to animals in general" and introduces "the cell and the ascending order of units into which it is organized." This is followed by a systematic survey of the chief phyla of animals. In each chapter a group is first described in a semi-popular manner; then follows a somewhat more technical discussion of morphological features; and finally there is a systematic summary in which classes and orders are briefly characterized. A third section considers animals in relation to environment. A final section, entitled "The Origin of Animals," deals largely with evolution and heredity. The book has been written by an experienced teacher who has used good judgment in presenting what students may read with interest and assimilate. It is unfortunate that there are at times careless errors and uncritical or misleading statements. For example, probably most zoologists do not believe that "since a specialized animal is thought of as being higher in the scale than a generalized form the terms higher or advanced and lower or primitive are used as synonyms for specialized and generalized respectively" (p. 159). In 1688 Francesco Redi said, "Besides, 'low' and 'high' are unknown terms to Nature, invented to suit the beliefs of this or that sect, according to the needs of the case." Such illustrations as Figures 333 and 334 appear to be poorly conceived and executed. In the first a katydid is properly designated; in the second another katydid is called a grasshopper.

Elements of Modern Biology. By CHARLES ROBERT PLUNKETT. Henry Holt and Company, New York. viii + 540 pp. $3.00. This is a book by a teacher for teachers. It is an abridgment and modification of "Outlines of Modern Biology" by the same author. The work is divided into five parts: (1) Protoplasm, seven chapters; (2) Nutrition, five chapters; (3) Response, five chapters; (4) Reproduction, four chapters; and (5) Evolution, three chapters. The treatment is from the point of view of general biology. Plants and animals are often considered together as illustrative material, but they are usually more or less ignored as such in order to present the physical and chemical basis for the phenomena of life. There is much of chemistry and physics and little or no natural history. Some of the statements are misleading, peculiarly limited or uncritical: *e.g.*, the discussion of parasitism (p. 110) and tropisms (p. 267); and in the glossary the definitions of such words as aberration, absorption, activation, adhesion, alternation of generations, analogous organs, etc. (p. 513). The work is perhaps a little heavy for students who are beginning the study of biology, but gives a thorough and thoughtful survey of the principles of biology.

Principles of Animal Biology. By A. FRANKLIN SHULL, GEORGE R. LARUE and ALEXANDER G. RUTHVEN. xiv + 400 pp. 4th edition. McGraw-Hill Book Company, New York. 1934. $3.50. This is a revision of a well-known and successful text-book. It considers the principles of zoology rather than types

or taxonomy. Though it is perhaps somewhat difficult for college freshmen at times, it impresses one as a well-written work by thoughtful, careful and competent zoologists. A new feature of this edition is a chapter on elementary chemistry and its biological applications. In twenty-one chapters the following topics are considered: biology, cells, protoplasm, chemistry, metazoans, mechanical support and movement, materials and energy, internal transport, disposal of wastes, unity and control, reproduction, breeding habits, development, genetics, classification, ecology, geographic distribution, fossils and evolution.

Animal Biology. By ROBERT H. WOLCOTT. xvii + 615 pp. McGraw-Hill Book Company, New York. 1933. $3.50. This book advocates the following principles: "(1) Life has a chemicophysical basis; (2) life phenomena are the outgrowth of organization; (3) the central fact in life is metabolism; (4) animals may be arranged in a progressive series with reference to organization; (5) the most complex animals are most effective and also the most efficient from a metabolic standpoint; (6) man, as the highest of animals, can learn by the study of animal life the principles of the most effective living; (7) he can also understand more fully his place in nature and more justly judge the actions of his fellows; this in turn may contribute to his intellectual and spiritual development; (8) every problem concerned with living is essentially a biological problem and capable of analysis and solution by the application of biological principles." The text is intended for the use of college students. Its writer was a teacher of long experience who has thoughtfully presented the general facts and principles of biology. The book contains fifty-five chapters grouped into five parts: (1) Fundamental Principles, (2) Protozoa, (3) Metazoa in General, (4) Metazoan Phyla and (5) General Considerations. It is well illustrated, a few of the figures being original. At the end is an excellent glossary, which not only defines scientific terms but also gives brief statements concerning authors mentioned in the text.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TIMING DEVICE FOR TAKING MOTION PICTURES[1]

THE study of any morphological state attains its full value only when a record is taken of the stages which precede and which follow it. An apparatus was built to operate a motion picture camera automatically so that single exposures are taken in adjustable intervals from one second to ten minutes. When a film so exposed is projected with the normal speed of 16 frames per second the recorded process will be accelerated in a corresponding ratio.

In the recent literature several automatic devices were described, most of which are too elaborate, filling the space of a laboratory room, and being correspondingly expensive, while others show in their construction signs of amateurish work. Therefore, it became necessary to design a simple apparatus which is within the financial scope of any laboratory and yet is constructed precisely and sturdily to withstand long wear. This apparatus was built to operate the camera in exactly equal intervals, adjustable to any interval required, over long periods of time, and synchronously to put into action a source of light for each individual exposure; for it is obvious that the living object would suffer unnecessarily from the powerful light if it were not excluded during the long intervals between two exposures.

[1] The construction of this apparatus was made possible by a grant from the Committee on Scientific Research, American Medical Association, to whom the senior author expresses his obligations.

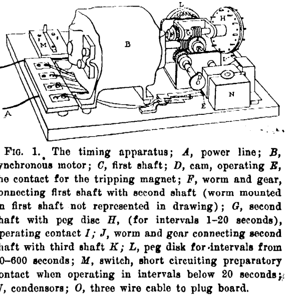

FIG. 1. The timing apparatus; *A*, power line; *B*, synchronous motor; *C*, first shaft; *D*, cam, operating *E*, the contact for the tripping magnet; *F*, worm and gear, connecting first shaft with second shaft (worm mounted on first shaft not represented in drawing); *G*, second shaft with peg disc *H*, (for intervals 1–20 seconds), operating contact *I*; *J*, worm and gear connecting second shaft with third shaft *K*; *L*, peg disk for intervals from 20–600 seconds; *M*, switch, short circuiting preparatory contact when operating in intervals below 20 seconds; *N*, condensors; *O*, three wire cable to plug board.

The equipment consists of a motor-driven impulse transmitter (timing apparatus), shown in Fig. 1, and B, B[1], in Fig. 2, and a tripping magnet (G, in Fig. 2) which by means of an adaptor ring is mounted on the motion picture camera. The timing apparatus transmits in regular intervals two current impulses. One operates the tripping magnet which—if energized—presses the release button of the camera for *one* picture. The other impulse lights the lamp (Fig. 2, K) for illuminating the object during the exposure.

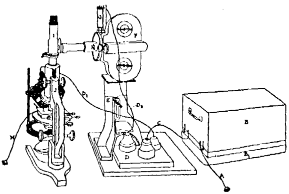

FIG. 2. General arrangement of the apparatus. *A*, power line; *B*, transmitter or timing apparatus; B_1, rubber mat; *C*, connecting line to the plug board; *D*, plug board; D_1, cable to microscope illuminator; D_2, cable to tripping magnet; *E*, base of the camera support; *F*, motion picture camera; *G*, tripping magnet; *H*, lateral, prismatic view finder (Goerz); *I*, "microphot" (Zeiss), bending the light by 90° from the vertical direction of the microscope horizontally into the camera; *J*, microscope; *K*, microscope illuminator; *L*, heating chamber; *M*, cord for heat chamber.

Since the incandescent lamp requires some time (from 1/20 to 1/5 sec.) to come up to brilliancy, the lamp must be lit a definite and constant time ahead of the tripping impulse. The transmitter is driven by a motor (Fig. 1, B) of constant speed. It has three shafts connected in sequence by gears in order to produce a stepping down of the number of revolutions per minute. On the first shaft (Fig. 1, C, highest speed) a cam (Fig. 1, D) is mounted which operates the contact (Fig. 1, E) for the tripping magnet. The second and third shafts (Fig. 1, G and K) bear a disk with a large number of equally spaced holes (Fig. 1, H and L). In these holes pegs are inserted which operate the contact in the lamp circuit. These pegs can be displaced by hand so that the contact can not be pressed when the disk is in rotation. Thus, the intervals between the impulses can be varied from 1 to 20 seconds (*i.e.*, 1, 2, 4, 5, 10, 20 seconds) depending on the number of pegs which press the contact during one revolution (Fig. 1, H). The length of one impulse is adjusted permanently in the machine (to approx. 0.6 sec.) by the location of the point of contact. For intervals longer than 20 seconds the second disk and contact (Fig. 1, L)—called the preparatory contact—is provided. This contact is in series with the lamp contact. While taking pictures in intervals shorter than 20 seconds, the preparatory contact is short-circuited by a switch (Fig. 1, M). If this switch is opened, the lamp contact can only close the lamp circuit when the preparatory contact is closed. In this way the intervals can be changed in steps from 20 to 600 seconds (*i.e.*, 20, 40, 60, 100, 200, 400, 600 seconds) by merely reducing the number of pegs in the second disk.

The different ratios of acceleration during *projection*, resulting from the different ratios of retarded *taking* of the pictures are computed in Table 1. It

TABLE 1

Interval between two pictures	Ratio of acceleration when projected with the physiologically adequate speed of 16 frames per second	A process of 12 hours duration is projected in:	Number of pictures in one hour
1 sec.	1:16	45 min.	3600
2 sec.	1:32	22 min. 30 sec.	1800
4 sec.	1:64	11 min. 15 sec.	900
5 sec.	1:80	9 min.	720
10 sec.	1:160	4 min. 30 sec.	360
20 sec.	1:320	2 min. 15 sec.	180
40 sec.	1:640	1 min. 7, 5 sec.	90
1 min.	1:960	45 sec.	60
1 min. 40 sec.	1:1600	27 sec.	36
2 min.	1:1920	22, 5 sec.	30
3 min. 20 sec.	1:3200	13, 5 sec.	18
10 min.	1:9600	4, 5 sec.	6

also contains the projection time of an actual event taking normally 12 hours and recorded with different ratios of acceleration.

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NOTE ON KEEPING LIVE FROGS FOR EXPERIMENTAL PURPOSES

SINCE the common experience of having frogs die in tanks, particularly in warm weather, is very disconcerting, it was thought worth while to insert in SCIENCE a note on our experience in storing these animals in a little electric refrigerator.

We have been able to keep a gross of frogs, in a hardware cloth box which fits in the bottom of our T. V. A. refrigerator, for a month with only three or four fatalities. They are dormant in the box (10° C.), giving only an occasional muffled croak as the machinery starts. When warmed, however, to room temperature, they become normally active with startling suddenness. Certain shipments, badly infected with "red leg," lasted surprisingly well in the refrigerator.

The only care we have given the animals has been to pick them over every day and to wet them with tap water.

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SPECIAL ARTICLES

A LETHAL MUTATION IN THE RABBIT WITH STIGMATA OF AN ACRO-MEGALIC DISORDER

A DWARF mutation in the rabbit was described in a previous paper.[1] In that instance the symptom-complex of affected animals suggested a diminished function of the growth-promoting hormone of the pituitary combined with basophilic over-activity and secondary disturbances of other endocrine glands. A contrasting abnormality of hereditary origin has also been found in the rabbit. When this affection was first seen, it was studied as a condition probably arising from a disturbance of thyroid function, and therapeutic tests, which were inconclusive, seemed to lend some support to this assumption. But it was later pointed out to us by Dr. H. M. Evans that the distinctive feature of the condition corresponded closely with the cutaneous overgrowth which Stockard[2] first recognized as a characteristic manifestation of acromegalic disorders.

This peculiar abnormality appeared several years ago in some hybrid stock derived from an inbred line of Dutch rabbits. It was traced back to a Dutch female, and unsuccessful attempts were made to fix the character for further study. Animals presenting the abnormality in typical form were comparatively rare, and these died at an early age. The few hybrids seen were more vigorous than the pure Dutch stock, and it was assumed that in the inbred line individuals of this class were probably lost before characteristic symptoms of the condition developed. Eventually, however, a small male presenting mild but typical symptoms of the abnormality was reared by the use of a foster mother, and breeding experiments were undertaken.

The distinctive features of the abnormality usually develop toward the end of the first or second week of life. A faint redness with an edematous thickening of the skin appears over the nape of the neck, between the shoulders, at the base of the skull, behind the ears or under the chin. This spreads to the whole ventral surface of the body and is particularly noticeable about the genital and anal regions. The condition increases rapidly. In typical cases, the skin of the entire body is thrown into loose, transverse folds. It is at first reddened, thickened and edematous with a glistening surface. Subsequently, the surface of the skin becomes covered with fine white scales and then with thicker crusts, while the skin itself becomes stiff and indurated. The hair is at first normal, but its growth is disturbed and it becomes coarse, sparse and stubby. As a rule, the growth of affected animals is at first rapid, but virtually ceases within a few days after the development of typical symptoms, and the disease progresses to a lethal termination in the course of a week or ten days. Mild and atypical, or "fugitive," cases of this affection also occur, and some of these animals are viable, but few have survived to a breeding age. The chances of survival are increased when affected animals are transferred to a foster mother, and advanced cases may be arrested by this form of treatment.

This abnormality occurs in animals of all sizes (birth weights), but in most instances the animals presenting these symptoms are exceptionally large and well nourished at the time of onset, while the small and wizened appearance of others first suggested the idea of a cretinoid abnormality, and in the end all seriously affected animals present this appearance. The bones have not been studied in detail, but skeletal overgrowth does not occur in all animals; some are large, others are small, and there is additional evidence that cutaneous and skeletal changes are to some extent separable and that one may occur independent of the other.

Breeding experiments based largely on the small Dutch male mentioned above have shown that the F_1 progeny from unrelated females is essentially normal. So far, attempts to reproduce the character in an F_2 generation, from animals obtained in this manner, have been unsuccessful. Only a few F_1 males have been tested, but none of these has transmitted the character. Still when certain F_1 females are back crossed to their male parent, typical cases of abnormality appear, while others, on repeated tests, have produced only normal young. Matings between the male referred to and F_1 daughters derived from unrelated females and known to be transmitters have given 15 typically affected and 44 normal young, exclusive of a few cases of mild or atypical abnormality, which is a close approximation to a 3 : 1 ratio.

These tests show that the male in question is heterozygous, despite the fact that he exhibited typical symptoms of abnormality in early life. He was derived from a mating of parents both of which were proven transmitters and, so far, all known male transmitters have been obtained in this fashion. Results from the reciprocal cross are uncertain. Only one female presenting definite symptoms of abnormality has been raised to breeding age and, in this case, repeated matings proved to be infertile. This animal also came from pure Dutch stock and from parents

[1] H. S. N. Greene, C. K. Hu and W. H. Brown, SCIENCE, 79: 2056, 1934.

[2] C. R. Stockard, "The Physical Basis of Personality," W. W. Norton and Co., New York, 1931. Herbert M. Evans, *Jour. American Medical Association*, 101: 425, 1933.

both of which were heterozygous. In this connection, it is of interest to note that this female was also of the small or dwarf type and that the male under consideration has shown a variable fertility with periods of diminished secondary sex characters and complete sterility. It has been found, however, that matings between heterozygous females and normal males produce only normal young, as in the case of affected male × normal female. No homozygous animal of either sex has been encountered among those tested.

The condition described is unquestionably inherited, and it is evident that in the F_1 generation the character is completely recessive. On the other hand, it is known that in matings between heterozygous parents the abnormality may be expressed in heterozygous males as well as in homozygous individuals, and that the homozygous form is apparently lethal. Until this situation is cleared up, ratios of normal to affected individuals can not be interpreted with certainty.

The disease described appears to fit into the syndrome which, at present, is associated with over-activity of the growth-promoting hormone of the pituitary. The apparent disturbance of thyroid function in certain cases may likewise be attributed to a pituitary abnormality affecting the thyrotropic hormone. In this instance, however, there is some evidence of an appreciable degree of differentiation, or separation, of cutaneous and skeletal manifestations of functional disorder. But further experiments will be necessary to determine the etiology of the condition as well as the precise mode of its inheritance.

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THE MODE OF PENETRATION OF PEAR AND APPLE BLOSSOMS BY THE FIRE-BLIGHT PATHOGEN[1]

A study of the mode of penetration of the fire-blight pathogen into pear and apple blossoms has revealed some facts which seemingly are significant from a point of view of possible control measures. Histological studies of both natural and artificial infections, which will be fully illustrated by photomicrographs and drawings in a later paper, reveal the following.

There is a well-defined cuticle covering the nectarial region of both pear and apple blossoms.[2]

[1] Research Paper 352 Journal Series, University of Arkansas.

[2] Professor L. H. MacDaniels, of Cornell University, has confirmed and amplified the writer's findings concerning cuticular covering of nectarial regions of pear and apple blossoms.

The nectar, instead of exuding from naked cells, as commonly assumed, passes out through stoma-like openings, the openings seemingly being regulated by guard cells, as in true stomata. For these nectar-exuding structures the writer proposes, for convenience, the name "nectarthodes." They have previously been noted in nectarial regions of other blossoms by various authors.

In the nectarial region of pears and apples, the fire-blight pathogen gains entrance into the interior by means of these nectarthodes, though entrance through these is apparently not nearly as common on apple blossoms as on pear. The reason for this difference rests essentially in the narrow, elongated, tightly covered calyx cup, characteristic of apple blossoms during nectar flow, contrasted with the broad, open and shallow calyx cup, characteristic of pear blossoms.

In addition to penetration through nectarthodes, *Erwinia amylovora* has no difficulty penetrating the following: First, the stigmatic surfaces of both pear and apple gynoecia, the large glandular naked cells of these surfaces making penetration under suitable conditions a relatively simple matter. The manner of such penetration will be fully illustrated elsewhere. Second, the locules of the anthers, with a seeming passage into filaments. The passage from anther to filament has not been fully confirmed.

These common methods of penetration of pear and apple blossoms are additional to those which the writer and other investigators have previously reported, and which include penetration through stomata of calyx lobes and outer receptacle walls, as well as through petals.

If floral infections of apples depended entirely on nectarial penetration, what chance would there be of controlling blossom infection by depositing a germicidal spray with ordinary spray-equipment in such tightly covered plant parts?

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BOOKS RECEIVED

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SCIENCE

VOL. 81 FRIDAY, JANUARY 11, 1935 No. 2089

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

MATHEMATICS AND SCIENCE[1]

By Professor CHARLES N. MOORE
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THE retiring chairmen of Section A have frequently devoted their addresses to some large phase of mathematical theory connected with their own scientific work. Since their audience and doubtless the bulk of their readers constitute a group whose primary scientific interest is in the field of mathematics, this has been an appropriate procedure. I have chosen to give a somewhat different type of address, for which I think there is also adequate justification. The American Association for the Advancement of Science is an organization that stands for cooperative enterprise among the various scientific groups. I have always felt that an emphasis on the connection between mathematical progress and general scientific progress should constitute one of the most important activities of Section A as a separate entity. For that reason I have elected to speak on the relationship between mathematics and science.

The origins of mathematics and science are lost in the mists of antiquity. As far back, however, as it has been possible for historians in these fields to trace the records, it has been found that science in general and mathematics in particular have undergone a simultaneous and parallel development. A little reflection will convince any thoughtful person why this must have been the case. It is quite apparent that astronomy, one of the earliest fields to attain what may properly be called a scientific form, could not have been seriously advanced without the assistance of a well-developed mathematical apparatus. Even the most descriptive form of scientific development in other fields could hardly have had its inception without making use of counting and calculation. It is well to recall that these elementary phases of mathematics, now become a matter of pure routine, were,

[1] Address of the vice-president and chairman of the Section of Mathematics, American Association for the Advancement of Science, Pittsburgh, 1934.

in the infancy of the subject, mathematical discoveries of a very high order.

The usefulness of mathematics in other fields has sometimes led superficial observers to urge that mathematicians as a class should devote their time exclusively to problems which are of immediate concern to other scientists. Without touching on the question as to whether or not it is beneath the dignity of mathematics to play the rôle of a glorified valet to the other sciences, the whole history of mathematics and science shows that from a purely utilitarian standpoint this course would be eminently short-sighted.

The notion of number undoubtedly had its beginning in man's sense perceptions; the conception of a number as a purely abstract idea, however, was a great triumph of creative imagination and paved the way for much of the vast development of mathematical theory. The operation of counting was closely associated with practical needs, if in fact it did not originate from them. All the fundamental operations of elementary arithmetic can be reduced to a question of counting, if we restrict ourselves to the positive integers in connection with which they arose. When, however, these operations were examined as independent processes, the investigations eventually resulted in a very extensive elaboration of the number class. We find illustrated here one of the most important procedures that lead to mathematical growth; namely, a synthetic process followed by an analytic process. We synthesize a large number of related ideas into a more general idea for the purpose of economy of thought and economy of procedure. Then we analyze the more general idea for all its ultimate implications and, lo and behold, a host of new ideas is found to be contained in our generalization. It has very much the appearance of rabbits tumbling out of a magician's hat, but here there is no hocus-pocus. Creative imagination and strenuous intellectual labor have succeeded in enriching our stock of mathematical ideas.

The process of growth to which we have referred is again illustrated in striking fashion in the passage from arithmetic to algebra. The first synthesis of various arithmetical operations into an algebraic formula goes back into the prehistoric period of mathematics, for we find such a synthesis appearing in the earliest known mathematical writings. It could not have been said to have been properly completed, however, until our modern algebraic notation took form. From that time on the analysis of algebraic operations, which had already been carried forward to a considerable degree, grew apace. We have the so-called imaginary and complex numbers appearing first as purely formal solutions of certain types of algebraic equations, then being recognized as independent entities and given a concrete geometric representation, finally being assimilated into a complete number system and forming the basis of a beautiful mathematical theory with wide ramifications, namely, the theory of functions of a complex variable. It is well known that for some time past this theory has found extensive applications in many branches of mathematical physics. In the newly created spinor analysis complex numbers seem to enter in some essential manner, rather than merely as a tool, as Veblen has recently pointed out.[2] Does any one believe that mathematicians would have arrived at the notion of complex numbers, to say nothing of extensive theories concerning them, if they had confined themselves to problems having immediate practical applications?

The failure of the methods of solution which had been effective for quadratic, cubic and biquadratic equations to yield similar success in the case of quintic equations led finally to Abel's brilliant discovery of the impossibility of such success. A systematic analysis of algebraic equations of higher degree at the hands of Galois led to the notion of groups of transformations. Thus we see emerging the basic ideas which are at the foundation of the theory of groups. In the present century we find far-reaching applications of this theory in the field of mathematical physics by Weyl, Wigner and others.[3] The consideration of sets of linear algebraic equations led first to the notion of a matrix and then by the natural laws of mathematical growth to a comprehensive theory of matrices, including infinite matrices. Quite recently this general matrix theory has been of important service to Heisenberg and other mathematical physicists. It is difficult to see how either group theory or matrix theory could have been evolved by mathematicians who were concentrating their attention exclusively on problems with an immediate physical significance. The mathematicians have created these theories in what seems to have been the only possible way, namely, by developing the science of mathematics along its own inherent lines of growth.

The postulates of Euclid represent the ultimate step in the Greek synthesis of geometric ideas and relationships. On these postulates as a basis a comprehensive geometric theory was elaborated by purely logical processes. An important part of this theory dealt with the curves known as conic sections. Thus an extensive knowledge of the geometric properties of these curves was attained by mathematicians who

[2] Oswald Veblen, SCIENCE, 80: 415–419, 1934.

[3] Herman Weyl, "Gruppentheorie und Quantenmechanik," Leipzig, 1928, 1931 (English translation of 2nd edition by H. P. Robertson). Eugen Wigner, "Gruppentheorie und ihre Anwendung auf die Quantenmechanik der Atomspektren," Braunschweig, 1931.

were advancing their subject in the manner its own nature demanded and not merely for the applications. Centuries later the astronomer Kepler found that the theory of conic sections was precisely what he needed to develop the laws of planetary motion.

The substantial completion of the synthetic operation involved in developing an effective algebraic notation paved the way for the next great step in the development of mathematics. This was the synthesis of algebra and geometry as then known into the analytic geometry of Descartes. This noteworthy advance is usually regarded as the beginning of modern mathematics, and certainly the growth of mathematical theory was enormously stimulated by it. Although this discovery is something less than three hundred years old, it has now so penetrated the thinking of the whole literate group that the newspapers of the day do not hesitate to use graphical representation.

The basic ideas of the differential calculus and the integral calculus developed in somewhat closer touch with the applications than in the case of many other mathematical theories. However, the recognition by Newton and Leibniz of the close relationship between the two methods of investigation and the binding link between their fundamental concepts ranks among the most brilliant mathematical syntheses due to individual effort. This synthesis having been made, the subsequent analysis resulted in forging the most powerful method of mathematical investigation which had yet been known. The calculus thus established enabled Newton to substantiate his theory of gravitation by deducing Kepler's laws from it, and his successors during the next two centuries to develop a comprehensive and majestic theory of the motions of the heavenly bodies.

In connection with the postulates of Euclid we find arising a new type of analytic procedure, namely, the analysis of the logical foundations of a subject to see whether or not they can be improved. The long struggle to prove the parallel postulate from the other postulates finally led to the construction by Bolyai and Lobaschevsky of logically consistent geometries in which the parallel postulate of Euclid was replaced by an essentially different one. Thus we have the origin of the non-Euclidean geometries. Until quite recently the majority of scientists in other fields, if they knew anything about the non-Euclidean geometries at all, must have felt that they should be ranked among mathematical recreations rather than as a serious scientific study capable of application to the physical sciences. The general relativity of Einstein shows that this is far from being the case, and that without the theories which grew out of the logical qualms of the mathematicians it would not have been possible to replace Newton's theory of gravitation by a more general one. For this task there was needed not only the geometric ideas involved in the non-Euclidean geometries, but also the related analytical development known as the absolute calculus.

The importance of trigonometric series seems to have been first indicated in connection with the applications of mathematics to physics, and it was in connection with such applications that Fourier laid the basis for a comprehensive study of them. After Fourier, however, these series were studied by various eminent mathematicians from the point of view of their own mathematical content, aside from their utility in the applications. It has been pointed out in a previous address[4] by a retiring chairman of Section A how this study led to the development of many of the important new notions of nineteenth century mathematics, such as the Riemann integral, the point-set theory of Cantor, etc. In fact, the whole present form of the theory of functions of a real variable has been largely conditioned by ideas which arose in connection with the detailed study of trigonometric series. This is one striking instance of many cases in which mathematics owes a debt to other sciences for suggesting problems which lead to noteworthy advances. I have insisted before that it would be a grave mistake for mathematicians to devote themselves exclusively to problems which arise in other sciences. It would also be a grave mistake to ignore such problems. For in addition to aiding in the development of the other sciences, the complete analysis of the problem from a mathematician's view-point often leads to important new ideas. However remote these ideas seem to be from the original problem, they frequently find application in the same or related sciences. It was by means of trigonometric series that Weierstrass and others succeeded in giving examples of continuous functions which nowhere possess a derivative. Fourier and his contemporaries, to say nothing of mathematical physicists of later generations, would have undoubtedly regarded such functions as excellent examples of the manner in which mathematicians sometimes waste their time. Yet an eminent physical chemist of the day, Jean Perrin, has pointed out that careful studies of the Brownian movement show that the trajectories of the particles suggest nothing so much as continuous functions without a derivative. In Chapter IV of his book "Les Atomes" we find the statement:

> The entanglements of the trajectory are so numerous and so rapid that it is impossible to follow them and the trajectory noted is infinitely simpler and shorter than the real trajectory. Likewise, the mean apparent velocity of a particle during a given time varies wildly in magnitude and direction without tending to a limit when the

[4] E. B. Van Vleck, SCIENCE, 39: 113–124, 1914.

time of the observer decreases, as we see in a simple fashion by noting the positions of a particle in the camera lucida, first from minute to minute, and then every five seconds, or better still by photographing them each twentieth of a second, as has been done by Victor Henri, Comandon and de Broglie, in order to cinematograph the movement. One can no longer fix a tangent, even in approximate fashion, at any point of the trajectory, and we have a case where it is truly natural to think of those continuous functions without derivatives, which the mathematicians have devised and which one would regard erroneously as mere mathematical curiosities, since Nature suggests them as well as functions with a derivative.

In the preface to the same book Perrin takes occasion to justify at some length, and in admirable fashion, the more recondite labors of the mathematicians. Since the statements of a physical chemist can hardly be qualified as mathematical propaganda, I think it will be of interest to repeat some of his remarks.

We all know how, before a rigorous definition is given, we point out to beginners that they already possess the notion of continuity. We trace before them a beautifully smooth curve, and we remark on placing a ruler against the contour: "You see that at each point there exists a tangent." Or again, to communicate the still more abstract idea of the true velocity of a moving body at a point of its trajectory, we say: "You surely perceive, do you not, that the mean velocity between two neighboring points of this trajectory becomes approximately constant when the points approach each other indefinitely?" And many minds, indeed, remembering that for certain familiar movements it appears to be so, do not see that the situation involves great difficulties.

The mathematicians, however, have well understood the defect in rigor of these so-called geometric considerations, and how childish it is, for example, to attempt to demonstrate, by tracing a curve, that every continuous function possesses a derivative. Functions with a derivative are the simplest and the easiest to deal with, but they are nevertheless an exceptional case; or, if we prefer geometric language, curves which have no tangents are the rule, and the very regular curves, such as the circle, are very interesting but very special cases.

At first glance such restrictions seem to be only an intellectual exercise, ingenious without doubt, but definitely artificial and sterile, involving the pushing to a mania of the desire for complete rigor. And, most frequently, those to whom one speaks of curves without tangents or functions without derivatives, begin by thinking that Nature does not present such complications nor even suggest the idea of them. The contrary is nevertheless true, and the logic of the mathematicians has kept them nearer to reality than the supposedly more practical representations of the physicists.

It is well to note here that many of the leading workers of the day in other scientific fields where mathematics is applied realize quite clearly that mathematics has served them best by following its own lines of development. In a recent article by Langevin[5] we find the following statement:

It is nevertheless just and necessary to emphasize here the remarkable fact that among the abstract constructions realized by the mathematicians, while taking for an exclusive guide their need for logical perfection and increasing generality, none seems to remain useless to the physicist. By a singular harmony, the needs of the mind, desirous of constructing an adequate representation of reality, seem to have been foreseen and provided for by the logical analysis and the abstract esthetics of the mathematician..

We also find in a recent paper by Dirac[6] the following remarks:

The steady progress of physics requires for its theoretical formulation a mathematics that gets continually more advanced. This is only natural and to be expected. What, however, was not expected by the scientific workers of the last century was the particular form that the line of advancement would take, namely, it was expected that the mathematics would get more and more and more complicated, but would rest on a permanent basis of axioms and definitions, while actually the modern physical developments have required a mathematics that continually shifts its foundations and gets more abstract. Non-Euclidean geometry and non-commutative algebra, which were at one time considered to be purely fictions of the mind and pastimes for logical thinkers, have now been found to be very necessary for the description of general facts of the physical world.

Finally, in a recent presidential address before the British Association for the Advancement of Science, we find the following statement by Jeans:[7]

Our knowledge of the external world must always consist of numbers, and our picture of the universe—the synthesis of our knowledge—must necessarily be mathematical in form. All the concrete details of the picture, the ether and atoms and electrons, are mere clothing that we ourselves drape over our mathematical symbols—they do not belong to Nature, but to the parables by which we try to make Nature comprehensible. It was, I think, Kronecker who said that in arithmetic God made the integers and man made the rest; in the same spirit, we may add that in physics God made the mathematics and man made the rest.

After such eloquent testimony in behalf of my thesis from distinguished workers in other scientific fields, I can only make suitable acknowledgement by repeating

5 Paul Langevin, "L'orientation actuelle de la Physique," in "L'orientation actuelle des Sciences," Paris, 1930.

6 P. A. M. Dirac, *Proc. Royal Society, London*, 133A: 60–72, 1931.

7 J. H. Jeans, *Nature*, 134: 355–365, 1934.

my previous injunction to workers in pure mathematics that they should keep in touch with the developments in other sciences. It will always be eminently desirable that at least some of the mathematicians should be on the alert for new problems which arise from sources outside of mathematics. Such problems have provided a powerful stimulus of growth in the past and will undoubtedly continue to do so.

At the present stage of development of both mathematics and science, the relationships between them and their mutual services are best illustrated in the fields previously mentioned, namely astronomy, physics and physical chemistry. There exists no branch of science, however, in which some mathematical procedure is not found essential. Moreover, the natural evolution of all scientific theory is in the direction of increasing use of quantitative methods. It seems inevitable that the applications of mathematics in the more descriptive sciences should be enormously extended in the future. Many indications of the processes leading to such extension can be found in recent scientific advances in various fields. For example, the application of statistical methods in the biological and sociological fields is steadily increasing. In view of the fact that in the recent past no special mathematical preparation was regarded as important for workers in these fields, such an increase is noteworthy. We also find cropping up in these same sciences quite unexpected and rather startling instances of the possibilities of mathematical application. An example of this is found in the curve of healing of a wound developed by Carrel and du Noüy[8] during the late war.

In a recent article by Lapicque[9] we have clear indication as to the manner in which the relatively new science of physiology is evolving into a form where mathematical applications will be not only possible but essential. His remarks are as follows:

Formerly, not very far back in the history of humanity, let us say a century ago, almost everything was unknown concerning the physiology in the labyrinth of a living body. Magendie said: "I wander around there like a rag picker, and at each step I find something interesting to put in my basket." This maxim horrified my teacher, Dastre, who was wont to say: "When one doesn't know what he is looking for, he doesn't know what he finds." For him the ideal of physiological research would have been to conceive in the quiet of one's study a theory explaining such and such a phenomenon, known but not understood (physiology is full of phenomena of this character), then to find, still by meditation, the experiment capable by a yes or a no, of proving or disproving the theory. One would come then some morning to the laboratory, and that very evening the matter would be decided.

These two tendencies, each in its amusingly exaggerated form, seem to me to serve the purpose of characterizing the temperament of naturalists and that of physicists. In proportion as physiology develops, the discoveries for rag-pickers become more rare, and the possibility of working as Dastre dreamed is approaching. The progress of the physical sciences is one of the essential conditions of this development. Physical chemistry, notably the new fashion of interpreting the statics and dynamics of solutions, the rôle of membranes, the infinite variability of colloids, has opened for us new horizons and permits us to understand many phenomena which the older chemistry did not explain. To-day, we tend more and more to explain the vital processes in terms of physical chemistry; we have before us an enormous domain to exploit in this manner.

Certainly if the physiologists are going to explain vital phenomena in terms of physical chemistry, they will need to make extensive use of mathematical methods. Colloids, for example, which are mentioned above, are referred to by Perrin as one of the aspects of nature which suggest continuous functions without a derivative. It seems quite reasonable to suppose that many of the future applications of mathematics in such fields as the biological and sociological sciences must wait on further development of mathematical theory as well as further development of the sciences in question. We should remember that the absolute calculus only reached definitive form some fifteen years before the publication of the first paper on general relativity. The present extensive development of the mathematical theory of atomic structure depends in part on advances in pure mathematics which are of quite recent origin. The inner details of biological phenomena are undoubtedly more complex than atomic structure, and the extensive application of mathematics to biology will in all probability involve mathematical theories as yet unborn.

On the other hand, we have in existence beautiful and extensive theories of pure mathematics which have as yet found no application in other scientific fields. One outstanding example of this sort is the theory concerning the distribution of prime numbers among the other integers. Since all integers can be expressed as the products of primes, and since all the other numbers of mathematics rest on integers as a basis, there is ample justification for the statement of Landau that the prime numbers should be regarded as the "building stones" of mathematics. Recent developments in physical theory suggest that the assumption of a discrete structure for the material world, rather than a continuous structure, is more in

[8] P. Lecomte du Noüy, "Recherches expérimentales et applications des méthodes de mesure et de calcul a un phénomène biologique: la cicatrisation," Paris thesis, 1917.

[9] L. Lapicque, "L'orientation actuelle de la Physiologie," in "L'orientation actuelle des sciences," Paris, 1930.

accordance with physical reality. Perhaps prime number theory, like the conic sections of the Greeks, is waiting for some future Kepler to derive from it important theories concerning the physical universe.

The point that I would like to insist on in closing is the essential unity of all that can be designated as science. One outstanding purpose lies at the basis of all scientific endeavor, as the etymological origin of the word science indicates. We wish to increase our knowledge, both of ourselves and of the world about us. In carrying out this purpose each individual works best along lines dictated by his own tastes and inherent capacities. Some of us are for this reason mathematicians, and more particularly mathematicians working in certain special fields. If the theories we develop had no bearing at all on other scientific work, they would still have a value as exhibiting the capacities of the human mind. But the interrelations of the various scientific fields adds much to the solidarity of scientific interests. We should therefore rejoice that the relationships between mathematics and the other sciences are of such great service in the general development of scientific thought. It may not make our work any more interesting to ourselves, but it adds much to its broad human interest.

AGRICULTURAL PLANNING AS AN ASPECT OF STATE AND NATIONAL PLANNING[1]

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AGRICULTURAL planning is proceeding in this country in two distinct but not unrelated forms. These two forms are perhaps best represented by the production control program of the Agricultural Adjustment Administration, on the one hand, and by the work of the Land Policy Division of the Agricultural Adjustment Administration and of the National Resources Board in conjunction with state planning boards, on the other hand.

The first of these types of planning, economic planning, tends towards a "planned agricultural economy" as that term is currently applied. It seeks to determine the quantity of certain agricultural products which the markets and consumption on the farm will absorb under existing and anticipated conditions, and the optimum carry-over in addition thereto, and to apply inducements, chiefly but not wholly financial, to accomplish such production. Before the inducements can be applied there must be the most thoroughgoing determination of the size of the agricultural plant most likely to yield the desired production under existing conditions without yielding disturbing surpluses. From production control as an immediate instrument this type of planning reaches out toward permanent adjustments in production, commerce and consumption of farm products such as will reestablish a normally balanced and compensating agricultural economy. This form of agricultural planning will receive somewhat extended treatment on the program of this meeting.

The second form of agricultural planning, and the one which is an integral part of state and national planning as contemplated in the title of this paper, is an aspect of the effort to plan the highest economic and social utilization of the natural resources of the nation in the interest of present and future generations. Its essential character is revealed in the declared purpose of the National Resources Board to prepare a program on all "aspects of the problem of development and use of land, water and other national resources in their physical, social, governmental and economic aspects." As the National Resources Board and its predecessor, the National Planning Board, is responsible for the present nation-wide movement for state planning, the work of the state planning boards is designed to accomplish similar purposes with respect to the natural resources within the several states. In the pursuit of these purposes the interests of agriculture are served in highly significant ways. Agricultural planning, in respect of some of its more fundamental features, emerges from the work of the national and the state planning boards.

While the two types of planning proceed from basically different intentions, they inevitably meet at a number of points.

BASIC SOCIAL TRENDS

The requirements of the nation for land and its products, for transportation routes and services, electric power lines, water supplies, stream control and many other utilities and services are affected by certain social trends which require evaluation. The first essential in the making of any plans for the future development of a state or of any other area is an understanding of basic conditions and trends. The

[1] Address of the retiring vice-president and chairman of Section O, American Association for the Advancement of Science, Pittsburgh, 1934.

facts must be assembled to establish the past trends and migrations and the present tendencies in agriculture, in industry, in commerce and in population distribution and concentration. Has agriculture been expanding into or receding from any areas under study? If so, why? If the character of farming is changing, what is causing the change and what is its significance for the future development of the area? What changes in location, size and character of mechanical industries have been taking place, why, and of what significance are the changes? What is the effect of these changes on migrations to or from the farms and on the demand for farm products? To what extent and in what industries and localities is decentralization of industry taking place or reasonably to be anticipated, and what adjustments in agriculture or the use of land, the development of highways and power lines, and the like, does such relocation of industry require?

What has been, and is, the trend in the size, the composition and the location of the population? What shifts are taking place in the proportion of the population engaged in the principal occupation groups, as in farming, mining, manufacturing, commerce, the professions, etc., and what bearing have these shifts on the future agricultural development of the state and the nation? Planners can not omit the implications of the slowing down of population growth and the changes in the age distributions within the population on the requirements either in physical development or in the creation and location of social institutions and utilities.

In many parts of the country the suburban trend has reached such proportions that it requires recognition in state and local planning. Consideration must be given to the increase in the number of rural non-farm homes and of small part-time farms within the environment of cities out to distances of perhaps thirty miles, and to the effect of good roads and motor vehicles on the movement from the more congested centers to suburban towns and villages. Studies have revealed some very striking facts concerning this movement and its significance for the future development both of the central cities and of the suburban towns and neighboring villages, as well as for the countryside. Questions also arise as to how the process of rapid suburbanization in certain areas, especially those outside the limits of incorporated cities and towns, can be regulated so as to avoid present evils.

In some states the problem of stranded populations must be dealt with. The first step is to locate the cities, villages and rural areas which have a large permanently unemployed population. Then the task is to determine whether industries, and what industries, can be located in such areas, and whether the stranded populations can be assisted by subsistence homesteads, small farm or allotment projects or other specific means.

As all expenditures and procedures for state and national development should be related to the actual and the potential needs of the people, all other elements in planning must be undergirt with the pertinent social or population facts.

Rural Land-Use Planning

The largest contribution to agricultural planning arising from the current national and state planning activities will apparently lie in the determination of the most socially desirable uses of the rural lands of the nation and how those uses may be effectuated. As a basis for such determination there must be available knowledge of present uses, the requirements of the nation for agricultural and forest lands, the nature of the soil resources, the factors which may affect the size of the necessary agricultural plant—especially the implications of any change in the foreign market for agricultural products and the increasing mechanization of farming—and other facts essential to dependable judgments concerning the uses of the nation's non-urban land resources.

In approaching a better planned use of the rural lands, the planning agencies are facilitating a broad classification of the lands into their most appropriate uses, whether for agriculture, forests, fish and game refuges, parks or other uses. Both the physical and the economic classification of lands are essential. For these purposes the studies involve, together with all pertinent economic data, the mapping and careful consideration of soil fertility, topography, length of growing season, rainfall, present intensity of use, school population and facilities, accessibility and other matters. A predominant purpose is to map the problem areas, the areas clearly submarginal for agriculture, and similarly to map the various categories from the marginal to superior farming areas, as a guide to the location of improved roads, electric power lines, recreational facilities, forests, wild life areas and other social utilities.

In many states, as a result of forest removal, loss of soil fertility, erosion, shift of population, changes in farm practises, especially the growth in machine farming, and other changes, great areas have gone out of cultivation, or nearly so, and have become problem areas. Much of this land is submarginal for agriculture. It must be located, mapped and described, and its possible alternative uses determined. While the chief alternative uses may be grazing, tree growth, water conservation, fish and game preserves, recrea-

tion and scenic or scientific reservations, there are many minor alternatives.

With the question of determining the alternative uses of submarginal areas goes the determination of how such lands should be owned or administered; by what legislative or other processes the desired developments may be inspired under private ownership; what areas should be purchased by the national, state or lesser governmental units for public reforestation, wild life preserves, water control, checking erosion, recreation or other desirable public enterprises.

Planning calls for careful determination not only of the uses to which the various types of land are best suited but also the requirements of the population for different categories of farm land, for forest products, water conservation, recreation areas, especially fishing and hunting areas, parks and camp grounds, wild life preserves and any other economic or social requirements which the non-urban lands may serve. The practicability of combined or multiple uses of land to serve these varied purposes requires determination.

Special problems of many sorts arise, such as those concerned with the possible development of extensive pasture areas on some of the hill lands in the east and the control and utilization of the range lands in the west; problems of the readjustment of size of holdings and types of farming, where maladjustments in these respects are evident; and problems arising from the menace of the soil and wind erosion, the former of which, at least, is taking heavy toll in all parts of the nation.

Closely related to these problems are those which deal with the changes in local governmental organization, in public services and utilities, in state aid to schools, and in road construction that are desirable in view of the probable future uses of these lands. Should the submarginal lands be zoned against future farm settlement? To what extent can the present population of these non-agricultural areas be absorbed in the activities, such as reforestation, recreation, game preserves and the like, which will take the place of such farming as is now practised? What procedures can be adopted to induce some of these submarginal farm families to settle on the more productive farm lands? These and kindred social questions obviously confront the planning agencies.

The Transportation Systems

In the field of transportation the facts must be assembled for all existent or prospective types of transportation, rail, water, highway and air transport. The mapping of all existing facilities, differentiated as to character and the trends and the intensity of use are first steps. The questions of truck routes, farm-to-market roads, the place of the improved highway in a complete transportation system, the extent to which the public highway should supplement or supplant the railroad, the development of the highway and its borders to increase highway efficiency and to create or preserve beauty of the countryside, are some of the questions which enter. The relation of the development of transportation facilities to prospective land use is obviously very important if costly errors are to be avoided. So also are the relations to the trends or migrations in population, in industry and in commerce.

The Water Resources

The water problems are always important and in some areas are paramount. There is the question of securing and protecting adequate supplies of water for the large metropolitan areas, a matter of grave concern in the more densely populated sections of the country; of adequate supplies for the smaller centers for commercial and domestic use; the overcoming of serious stream pollution, which is a burning question in many places. There is the problem of flood control and its relation to soil erosion, afforestation, land use, swamp drainage and water storage and conservation. There is the problem of declining reservoirs of ground water and the control and protection of water for irrigation purposes. Attention must be given to the regulation of developments along streams and beside the public waters.

Power Production and Distribution and Industrial Location

In any study and mapping of the water resources of a state the question of power production is likely to gain prominence. This requires mapping and measuring both the developed and the undeveloped water power resources within the state, and determining what is involved in developing potential but now unused resources. Power production and distribution bear directly on the location of industries, existing and potential. Mapping the existing high tension distribution lines throws light on what the future problems of power distribution and utilization are. In the industrial states, a vital question is the relation of electric power distribution to the decentralization of industry. There are questions of major social significance bound up with the question of industrial location. In probably all the states the requirements for farm electrification should have clear recognition in planning; the relation of prospective land use to the extension of rural electric power lines scarcely requires discussion. In a number of states consideration must also be given to locations favorable to the production of electric power by steam.

PUBLIC WORKS PROJECTS

In state and national planning much emphasis has been given to public works which might relieve unemployment. This is an immediate phase, and it is also a major concern of long-term planning. As all manner of public works are appropriate for consideration, many items which directly concern farming and country life have place: the requirements of the population in the matter of highways, including farm-to-market roads, bridges, canals, parks, forests, fishing and hunting preserves, irrigation and drainage works, stream and flood control and water conservation are examples. There is involved consideration not only of what is required, but where and how it should be provided, its relation to all other pertinent state developments, and an effort to indicate the relative urgency of the many proposed public works.

MISCELLANEOUS ITEMS AFFECTING THE RURAL POPULATION

While state and national planning, having as its central objective the conservation and wisest utilization of the natural resources of the nation, places major emphasis on such questions as have just been enumerated, in many states much attention is given to other matters which are essential elements in arriving at reliable judgments. As examples of these may be cited the bearing of land values, taxation and tax delinquency on the actual and the potential use of various types and areas of land. In some states planning with respect to the social resources and needs are a definite and coordinate part of the program. Here one finds attention being given to housing and living conditions, both urban and rural; problems of health and sanitation; the facilities and requirements for mental hygiene, social welfare and education, especially public-school facilities; governmental reorganization for the various units of government; landscaping and beautification of public properties. Such matters may be of quite as great concern to the rural as to the urban dwellers.

While the limits of this discussion have necessitated treatment only in somewhat broad categories, it will be obvious that before even tentative plans can be formulated in any major segment of the field, extensive and varied bodies of detailed facts must be assembled and analyzed. Much of the basic factual material is available, but it requires to be brought together, integrated or correlated and interpreted. The planning agencies, however, have found it necessary to fill many gaps in essential knowledge by conducting or inspiring additional surveys and investigations.

THE POTENTIALITIES OF THE PLANNING MOVEMENT

While forty-two states have created planning boards to cooperate with the National Resources Board and their programs contain many common elements, it is inevitable that there will be much variation not only in the scope of the work and the extent of collaboration among the responsible state departments and agencies, but also in the vigor and competence with which the work is pressed. The values for agriculture, as for other interests of the respective commonwealths, will correspondingly show great variations. None the less a great new light has shone upon the possibilities and significance of agricultural planning, and facts of compelling importance are being marshalled. If the present planning movement survives, and if in even modest degree it approximates its potentialities, farming and rural life in America stand to gain in many ways vital to rural social and economic progress.

The whole movement has not only yielded vast bodies of knowledge and correlations of survey and research findings hitherto unavailable in such revealing form, but more significantly it has fostered comprehensive thinking about the land and water resources of the nation, the facts which influence agricultural prosperity and attractiveness in this country, and the place of agriculture and the amenities of rural life in any proposals for state and national development. For the first time large numbers in the population have come to see the unity of national life and the interdependence of the elements in our social economy. It should be less easy in future for certain kinds of public undertakings of questionable value or likely to serve special interests at the expense of more general interests to make headway. It should be possible to proceed with public enterprises with more confidence because of the wider horizon which the planning studies afford.

OBITUARY

OTTO FOLIN

OTTO FOLIN, who died in Boston on October 25, 1934, was a widely known biochemist. He achieved distinction by important contributions in the field of metabolism, by the inspiration and guidance he gave to many students and associates in his laboratory at the Harvard Medical School and by his skill and resourcefulness in designing numerous analytical methods which proved widely useful both in biochemical research and as valuable aids in medical practise. He will be missed by numerous colleagues and friends, who from personal contact as well as from acquaintance with his work came to regard him with admiration and affection.

Folin's career shows how a foreign born young man with ability and determination but without either connections or financial resources found in America the means for education and the opportunity for high accomplishment in academic life. His professional work is a reminder of the paramount importance of technique and methods in the progress of science.

Otto (Knut Olof) Folin was born on April 4, 1867, in the village of Asheda in southern Sweden. His father, Nils Magnus Folin, was a tanner. His mother, Eva (Olson) Folin, a woman of ability and courage, was highly regarded over a large district which she served as the official midwife. When fifteen years old Otto joined the wave of Swedish immigration to America and went to live with his brother Axel in Stillwater, a lumber town in Minnesota. Working on farms and in a small hotel to support himself, he graduated six years later from the Stillwater High School. In 1888 he went to Minneapolis, found means of livelihood and successfully completed the undergraduate course at the University of Minnesota, receiving the B.S. degree in 1892. In the autumn of that year he entered the University of Chicago, which was just opening, as a graduate student in organic chemistry. Here, under the guidance of Stieglitz, he completed in 1896 a dissertation on Urethanes and was granted the Ph.D. degree in 1898. Deciding upon a career in physiological chemistry, he managed to go abroad and spent a year with Kossel in Marburg, another with Hammarsten in Upsala and a shorter period with Salkowski in Berlin.

Returning to America in 1898 with several papers published in *Hoppe Seyler's Zeitschrift*, Folin received his degree at the University of Chicago, but failed at first to find an opening in physiological chemistry, a subject then not widely appreciated in this country. The next year, however, he was appointed assistant professor of analytical chemistry at West Virginia University. With this opening into academic life, he married in September, 1899, Laura Churchill Grant, of St. Paul. He remained at West Virginia only one year, but gave there a course in physiological chemistry which so aroused the interest of his students that several of them (including the writer) decided to attempt careers in the subject.

In 1900 Dr. Edward Cowles, superintendent of the McLean Hospital for the Insane at Waverley, Massachusetts, invited Folin to establish there a research laboratory for the study of chemical problems related to mental disease. This was probably the first laboratory for biochemical research to be established by a hospital in this country. Folin soon concluded that the most hopeful approach to the problem was a careful and detailed study of metabolism, of normal as well as abnormal subjects, for which the facilities of the hospital were admirably suited. The work led to little of value to psychiatry, but paved the way for important advances in the field of nutrition and especially in other branches of clinical medicine. The value of its results to the McLean Hospital is indicated by the continuance of that laboratory.

Folin's first object was to determine accurately the quantities of the main constituents of the urine as an index and measure of the chemical reactions within the body which produce them. Most of the urinary constituents were then known qualitatively, but methods for their determination were in many cases so laborious or complicated that no approximately complete analysis of a single urine specimen had been accomplished, and complete consecutive daily analyses during a metabolism experiment were impossible. He, therefore, undertook the task of simplifying procedures for quantitative analysis of urine.

Among the methods Folin then devised was a *colorimetric* process for creatinin and creatin, notable not only because it is still the only one available for these substances but for the reason that it introduced the *colorimeter* into biochemistry and demonstrated the practical value of color comparison as the basis for analysis of small amounts of material. This instrument found wide application by Folin and by many others.

The use of his new methods for quantitative analysis in experiments with human subjects taking diets of known composition yielded results reported in a classic paper on "Laws Governing the Composition of Normal Urine" (1905). His interpretation of these data led to a "theory of protein metabolism" which emphasized the plural nature of the process and greatly altered the views widely held at that time concerning the immediate fate of food protein in the animal body. He was led to believe that food protein after digestion in the gastro intestinal tract was absorbed, not as then supposed in the form of protein resynthesized during absorption, but directly as small amino acid fragments.

The papers above cited together with his other work marked Folin as one of the leading biochemists of that period and led to his appointment in 1907 to the first chair of biological chemistry in the Harvard Medical School. There for twenty seven years he was an inspiring teacher and with numerous assistants continued the line of investigations started at McLean.

The next step was to look within the body for the products of food protein after its digestion in the intestines. Here again methods were lacking, there being at the time apparently no reaction sufficiently sensitive to measure with accuracy the small amounts of nitrogenous materials admixed with the abundant protein of blood and tissues. The simple direct way

in which Folin (with W. Denis) surmounted this difficulty is characteristic of nearly all his work and accounts for the practicability of his methods, a quality which permits their daily use in many laboratories throughout the world. Proteins and colloidal materials were precipitated without heat, the filtrate was submitted to a micro Kjeldahl digestion and the ammonia formed was determined colorimetrically by use of Nessler's reagent. This simple but skilful combination of well-known reactions into a practical method supplied the means of proving that amino-acids are absorbed directly from the intestine (a fact established simultaneously also by other investigators) and, what is perhaps of greater importance, provided a tool for the quick and accurate measurement of retention within the body of nitrogenous waste products as a result of failing kidney function.

Following his demonstration of its clinical significance, Folin's method for the determination of blood non-protein-nitrogen was immediately adopted by a number of investigators of medical problems. Its practical value as an aid in diagnosis becoming established, facilities and personnel for the performance of this and related methods were soon established in many hospitals. About the same time Folin—and others also—introduced practical methods of chemical analysis for other constituents of blood of clinical significance (creatinin, urea, uric acid and sugar). Out of these modern techniques, the earliest now only about twenty years old, supplemented by constant improvements and innovations, there has developed the present somewhat elaborate system of clinical biochemistry, practised in some degree in almost every hospital in America and rapidly spreading to other parts of the world. Although there is the suspicion, which Folin shared, that this novelty of blood chemistry is sometimes overdone, exploited or poorly performed, it represents an important advance in medicine and surgery. Any surgeon will testify, for example, to the aid given by a knowledge of a patient's blood "N.P.N." in deciding the risk of operation or in guiding preoperative care. In medical, pediatric and obstetric practise also, the information obtained by this and other methods of blood chemistry is for some conditions now regarded as almost indispensable. In this development many besides Folin have had important part, but to him is due the credit for its inauguration as well as for some of the best methods in constant use at present.

Although his methods and their practical value constitute, perhaps, Folin's principal service, it would be unjust to leave the impression that his contributions to the concepts of biochemistry are of less importance. His revision of our ideas concerning protein metabolism was fundamental and no less valuable because similar conclusions were reached simultaneously by others.

Folin took an active interest in the American Society of Biological Chemists, which he helped to found in 1906, and of which he was vice-president (1908) and its third president (1909). He regularly attended its meetings and took part in its programs as well as those of the Physiological and Pharmacological Societies, of which also he was a member.

Folin's early work appeared in *Hoppe-Seyler's Zeitschrift*, in which both his first (1897) and his last (October, 1934) papers were published, and in the *American Journal of Physiology*. After the establishment of the *Journal of Biological Chemistry* in 1905, most of his papers were sent to it. A member of its first group of collaborators, he became chairman of the editorial committee in 1920, when that journal became the property of the society. He remained until his death active and influential in the relations of the journal and the society. For many years Folin has been a member of the National Board of Medical Examiners, in charge of its examinations in biochemistry.

Among the honors bestowed upon Folin were: membership in the National Academy of Sciences; honorary membership in the Medical Society of Sweden; the honorary degree of Sc.D. conferred by Washington University (1915) and by the University of Chicago (1916); honorary M.D. by the University of Lund (1918); and the Scheele medal of the Stockholm Chemical Society (1930).

On the personal side Folin had admirable and lovable traits. Quiet and shy in manner, he did not seek wide acquaintance with people, but devoted his energy to work in his laboratory, to his departmental colleagues, to a few close friends, with whom he loved to play golf, and to his family. He possessed a quaint humor and a sane, quiet perspective toward life and work which impressed all who knew him as the qualities of a modest kindly gentleman. He was very fond of the mountains of New Hampshire, where he spent the summer months at his cottage on the slope of Kearsarge Mountain. There at its foot he is buried.

Dr. Folin is survived by his widow, their son, Grant Folin, now in business in Detroit, and a daughter, Teresa Folin, a physician now at the Children's Hospital of the University of Chicago.

PHILIP A. SHAFFER

TRIBUTE TO PROFESSOR FOLIN[1]

MY part in this afternoon's program is to speak of Dr. Folin from a dual point of view, that of an

[1] Remarks at a memorial meeting in the Harvard Medical School on November 23, 1934, at which time Professor Folin's portrait was presented.

internist acknowledging the significant value to clinical medicine and surgery of his biochemical investigations and that of a member of the medical faculty of Harvard University paying tribute to him as a stimulating teacher and leader and above all a wise, helpful and beloved colleague Though I may not speak in mellifluous diction nor with the wisdom of the ages, I do speak with the authority of one who daily in my care of patients now for many years has utilized the methods that Dr Folin perfected both for a better understanding of what ails sick humanity and as a guide in their therapeutic management and of one who for twenty seven years has sat with him in faculty and committee meetings, somewhat bedevilled his peace and comfort when I used the laboratory over his head and above all in personal contacts learned to know the quality of his mind and the character of his personality

You, my younger colleagues and students, scarce can vision medicine without the methods of blood analysis perfected by Folin and his pupils and those inspired by Folin's own accomplishments, so completely have these micro methods of quantitative analysis become a factor integrated into the web and woof of the fabric of clinical medical and surgical lore By such microchemical methods we follow the progress and guide the diet of those suffering from Bright's disease, using them for those approaching the period of the evils of prostatic hypertrophy, surgery has been made vastly safer, with their results at hand more successfully do we measure the needed insulin against the metabolic requirements for health in the diabetic and especially with them safely do we steer the diabetic between the Charybdis of acidosis and the Scylla of insulin shock, microchemical analysis makes possible the diagnosis of parathyroid tumors and allows the surgeon by their removal to cure serious bone disease or stay the formation in some of renal stones Folin's studies and microchemical methods of analysis have granted us a better understanding of gout and enlightened us on the mechanism of edema in anemia, renal disease, circulatory failure and a large group of nutritional disorders

Not all the methods have been the product of Folin's own hand or originated in Folin's laboratory, but it has been, however, from his own ingenious methods and the wisdom of his approach to important biochemical problems that has grown the whole range of microchemical analyses of the blood and other body fluids which are daily in use in hundreds of hospitals and thousands of doctors' offices the world over He was the recognized leader in this phase of clinical laboratory technique, and some of his own methods are probably always in use, for, as it has been said of the British Empire that the sun never sets upon it, so the sun somewhere always is shining on the laboratory determining something in the blood of patients by a Folin method As has the microscopist, so has Folin dealt with the very small, and his work has been determining accurately smaller and smaller amounts of various substances in the smallest possible bulk of blood or other body fluid The ultimate in this would seem to be the determinations by Richards and his pupils of glucose, sodium chloride, urea, uric acid and creatinin in the fluid from a single glomerulus and from a single tubule of the kidney using micro methods, based on Folin's investigations and perfected as a result of the guiding stimulus of Folin's work

When Folin entered the faculty of medicine it was composed of just under 50 members Of those men besides myself, only Cannon, Bremer, Lewis and Joslin remain in active service We are Folin's oldest faculty friends and longest have had the stimulus of his work and his ideals, the benefit of his wisdom and the fellowship of himself In this we have been particularly the elect, but in these intervening years many others have come to share him with us, until last year his influence was felt by 130 faculty colleagues

Folin now is a fine tradition in the Harvard Medical School not alone to the faculty but to the members of twenty six classes of medical students that in his laboratory have been instructed in biochemistry, his personality, his character, his wisely critical attitude toward men and their investigations, his friendly helpfulness to others, the restraint of his spoken word not failing in clarity, his modesty, his sense of humor and other qualities have endeared him to us

In his death we have lost a truly wise colleague, who was an ideal professor Long will the memory of him remain a potent factor in our individual activities That he lived and worked here among us is a cause of deep gratitude in the hearts of each and all of us, faculty and students of the Harvard Medical School

Henry A. Christian

SCIENTIFIC EVENTS

THE CONSTRUCTION OF A BARRAGE ACROSS THE TIGRIS

The construction of the barrage across the Tigris at Kut has been inaugurated by the Government of Iraq The consulting engineers for the works are Messrs. Coode, Wilson, Mitchell and Vaughan-Lee, Westminster, and the contract was awarded in September to Messrs Balfour, Beatty and Co., Limited, who expect to complete it within three years. Ac-

cording to the London *Times*, the estimated cost is over £1,000,000.

The plan provides for a barrage and a navigation lock on the Tigris at Kut and, higher up the river, a head regulator and a canal through which the waters of the Tigris will be diverted as required into the Shatt-el-Gharraf. This river, the course of which is southward to Nasiriyeh, on the Euphrates, at present runs dry when the level of the Tigris is low in the summer season, and the object of the works is to ensure a continual flow of water throughout the year. With the installation of pumps it will thus be possible to irrigate an immense area of land which, properly watered, has rich possibilities for the production of wheat and maize and cotton.

The barrage will be nearly 2,000 feet long with its approaches and will have 56 openings, each nearly 20 feet wide, controlled by sluice gates. Its height will be nearly 50 feet from the bottom of its concrete base to the road along the top. This road, 13 feet wide, will serve as a much-needed public bridge. The navigation lock will have an effective length of 260 feet and a width of 53 feet, and as the Tigris is used extensively by a species of salmon, a fish ladder, the first structure of its kind in Iraq, will be embodied in it, to allow the passage of fish up the stream. The Shatt-el-Gharraf Canal will be 3,250 yards in length and 90 yards in bed-width.

The Tigris Barrage is one of the three big irrigation works included in the Capital Development Works program of the Government of Iraq, which, originally in the nature of a five-year-plan, was passed into law in 1931. The first of these projects was the Habbaniyah Escape, one of the principal irrigation schemes proposed by the late Sir William Willcocks some years before the war. Its primary object was to provide an escape for the spring flood of the Euphrates by diverting it into the Habbaniyah Lake on the right bank of the river between Fallujah and Ramadi, at the upper end of the cultivable lands. The water level in the river then could be controlled south of Ramadi and thus the flooding of the river year by year, with the consequent heavy damage, would be almost entirely eliminated. The other scheme is the Abu Ghuraib Canal, a smaller operation, which is now under way. The line of this canal runs from the left bank of the Euphrates about six miles below Fallujah towards Baghdad. It is 40 miles long and is expected to water about 120,000 acres.

The Government of Iraq also contemplates the erection of a dam on the River Diala, at a point where it passes through hills about 70 miles north-east of Baghdad. The effect of this work would be to form a reservoir capable of raising the river's level in the summer months and thus of irrigating 1,500,000 acres of land suitable for cotton and wheat between Diala and Kut, the cost of which would probably be more than £1,000,000.

THE DROUGHT AND AUTUMN RAINS

OVER most of the interior states, the three fall months changed completely the weather picture of the preceding winter, spring and summer, so far as moisture is concerned, according to a statement made by J. B. Kincer, of the U. S. Weather Bureau. In many areas where unprecedented drought had hung on from the first of January until the last of August abundant rains fell in September, October and November. Even with the heavy fall precipitation, however, subsoil moisture remains deficient and the average rainfall for the year is bound to be below normal in many sections where the drought was most severe.

Above-normal temperatures in every state also distinguished the autumn of 1934. Very rarely are all the states on the same side of the normal temperature mark at one time. As a rule when one part of the country is warmer than normal, some other part is colder than normal.

The fall rains that turned the tables in the heart of the drought area brought approximately one and a half times the normal precipitation to states that for the preceding eight months had averaged about one half of normal. Thus, in Iowa precipitation was only 65 per cent. of normal for the eight months from January through August, but rose to 150 per cent. for the three-month period from September to November. In Nebraska the corresponding change was from 50 to 103 per cent.; in Kansas, from 57 to 134 per cent.; in Missouri, from 59 to 164 per cent., and in Illinois, from 67 to 154 per cent. The average precipitation for the year so far—which Mr. Kincer states is not likely to change materially between now and January 1, 1935—is 86 per cent. of normal for Iowa; 69 per cent. for Nebraska; 75 per cent. for Kansas; 85 per cent. for Missouri, and 90 per cent. for Illinois.

While the Middle West and the Central Valley were being well watered the eastern Ohio Valley was dry. Ohio, after a moderately dry summer, had only 80 per cent. of normal rainfall for September, October and November. The far Southwest and the northern Great Plains also continued dry through the fall. North Dakota, for example, had only 68 per cent. of its normal precipitation, following a 52 per cent. normal rainfall for the preceding eight months. This means an average annual rainfall of just a little more than half normal for North Dakota.

The Southwest started the year dry and stayed dry. Colorado had 67 per cent. normal rainfall from January through August and 62 per cent. for the rest of the year. In Utah the corresponding percentages were 63 and 90; in Arizona, 81 and 54, and in New Mexico, 69 and 66.

Fall rains were abundant in the Middle Atlantic States and in the Mississippi Valley States. Several of these had approximately one and a half times their normal precipitation—Wisconsin, 170 per cent. of normal; Maryland, 164 per cent.; Virginia, 152 per cent., and Mississippi, 148 per cent.

The East also had plenty of rain this fall, almost enough to make up for the lack earlier in the year. Georgia and Florida were the only exceptions. These two states were seriously dry the latter part of the fall.

THE PRESIDENCY OF THE AMERICAN CHEMICAL SOCIETY

As announced in last week's issue of SCIENCE Professor Edward Bartow, of the State University of Iowa, has been elected president of the American Chemical Society for 1936, serving as president-elect during 1935. He was elected from among six candidates nominated by the local sections. The names of these nominees, with biographical sketches, as printed in the news edition of *Industrial and Engineering Chemistry*, are as follows:

EDWARD BARTOW, 64 professor and head of the department of chemistry and chemical engineering, State University of Iowa, Iowa City, which post he has held since 1920. A graduate of Williams College, he received his doctorate from the University of Göttingen and his D.Sc. from Williams College. He has taught at Williams, the University of Kansas and the University of Illinois. He was director of the State Water Survey at Illinois from 1905 to 1917 and chief from 1917 to 1920. He served as lieutenant colonel in the Sanitary Corps, U. S. A., on duty in France, and he has been a member of several important commissions, has been prominent in the work of a number of scientific organizations and has held office in several of these. He has been active in the International Chemical Union, serving as councilor, and at Madrid he was elected vice president for the United States and was made a corresponding member of the Spanish Academy of Science. Dr. Bartow has served the American Chemical Society in many capacities and at present is a member of the board of directors.

W. D. HARKINS, 60, professor of chemistry at the University of Chicago, where he has served as a member of the faculty since 1912. He is a graduate of Stanford University, and received his doctorate there too. He studied also at the University of Chicago and at Karlsruhe. He taught at Stanford and at the University of Montana before going to Chicago, and in 1910 he was research associate at the Massachusetts Institute of Technology. He has served as lecturer at the Mellon Institute and at the University of Illinois, has been consulting chemist for the U. S. Bureau of Mines, and was special agent of the Department of Justice on smelter smoke investigations in 1910–12. He has performed extensive public service, being president of the Missoula Board of Health, and still serves on the Chicago Committee on Ventilation. In 1928 he received the Willard Gibbs Medal of the Chicago Section of the American Chemical Society. He is a member of the National Academy of Sciences, the Philosophical Society, and served as vice president of the American Association for the Advancement of Science in 1920. His work in the field of physical chemistry is outstanding.

ARTHUR J. HILL, 46, chairman of the department of chemistry at Yale University since 1927. He is a graduate of Yale, where he received his Ph.D. in 1913, and since that time he has been connected with the faculty of the university, beginning his service as an instructor, following the completion of his work for the advanced degree. He is a member of the committee on hypnotics and chairman of the Subcommittee on Local Anesthetics of the National Research Council. He served in the Chemical Warfare Service during the world war. He has long rendered valuable service to the American Chemical Society, having been chairman of the New Haven Section in 1925, of the Division of Medicinal Chemistry in 1929, and is now most active in the Division of Organic Chemistry, of which he is the secretary. His principal scientific interests lie in the field of synthetic organic chemistry, biochemistry and medicinal products and dye intermediates.

WALTER S. LANDIS, 53, vice president since 1922 of the American Cyanamid Company, with which he has been associated since 1912, when he became chief technologist in that organization. He is a graduate of Lehigh University, from which institution he also received his master of science degree and the D.Sc. He was a student at Heidelberg 1905–6 and in Aachen in 1910. He was an assistant in metallurgy at Lehigh 1902–4 and was then advanced to an instructorship, next assistant professor from 1910 to 1912. He has served as chairman of the New York Section of the American Chemical Society, also of the Electrochemical Society of which he was president in 1912. He holds membership in the American Institute of Mining and Metallurgical Engineers, the American Institute of Chemical Engineers, and is well known for his research and developments in nitrogen fixation, fertilizers and electric furnace products.

A. S. RICHARDSON, 44, in charge of chemical research of the Procter and Gamble Company since 1921. His training was received at Princeton University, where he received his A.B. in 1913, his A.M. in 1915 and Ph.D. in 1927. He was an instructor in chemistry at Princeton from 1915 to 1917 and again from 1919 to 1920. He was a member of the research staff of E. I. du Pont de Nemours and Company from 1920 to 1921. Dr. Richardson was president of the American Oil Chemists Society in 1931. Besides his activities in the American Chemical Society and the Oil Chemists Society, he is a member of the American Association for the Advancement of Science and of the Chemische Gesellschaft. His scientific interests lie in the fields of catalysis, fats, and soap.

E. R. WEIDLEIN, 47, director of Mellon Institute of Industrial Research since 1921. He is a graduate of the University of Kansas, where he was a fellow from 1909 to 1912, receiving his A.M. in 1910. Tufts College awarded him the honorary D.Sc. in 1924, and the University of Pittsburgh the LL.D. in 1930. He was a senior industrial fellow of the Mellon Institute, a director of the experimental plant from 1912 to 1916 when he became associate director. Dr. Weidlein has been active in a great many scientific enterprises. He has

served as chairman of the Pittsburgh Section of the American Chemical Society, as its councilor, as vice chairman of the Division of Industrial and Engineering Chemistry. He has been president of the American Institute of Chemical Engineers, as well as a director of that organization. He has been active in the Society of Chemical Industry, the Electrochemical Society, is a member of the Franklin Institute, the Faraday Society, various academies and similar organizations, including a number overseas. While for some years he has, of course, been fully engaged in matters of organization and the advance of the institute of which he is the director, he formerly had a special interest in heat insulation materials, hydrometallurgy, camphor and epinephrine. More recently his specialty has been industrial research methodology.

FRANK C. WHITMORE, 47, dean of the School of Chemistry and Physics, Pennsylvania College, since 1929. He graduated from Harvard University in 1911, took his A.M. in 1912 and his Ph.D. in 1914. He has been a member of the faculty at Williams College, Rice Institute, the University of Minnesota and Northwestern University, where he was head of the department from 1925 until 1929. Dr. Whitmore has been active in many scientific fields. He has served as chairman of the Division of Chemistry and Chemical Technology of the National Research Council and as a member of other divisions of that organization. He was a consultant of the Bureau of Chemistry and Soils and of the Chemical Warfare Service. He has found time to assist a number of publication enterprises, including the Encyclopedia Britannica and Organic Syntheses. He was a councilor of the International Chemical Union in 1931, is a member of a number of important chemical organizations, and has been devoted to the interests of the American Chemical Society. He has served as councilor of the Chicago Section, councilor-at-large, secretary and chairman of the Division of Organic Chemistry, and is now a director of the society.

SCIENTIFIC NOTES AND NEWS

BRITISH birthday honors conferred on December 3 include knighthood on Dr. Charles Vernon Boys, physicist, the Imperial College, London; Dr. Edward Bagnall Poulton, Hope professor of zoology at the University of Oxford; Dr. John Boyd Orr, director of the Rowett Institute for Research in Animal Nutrition, Aberdeen, and Professor Walter Langdon Brown, of St. Bartholomew's Hospital, London. Sir Holburt Jacob Waring, president of the Royal College of Surgeons, is advanced to a baronetcy. Dr. John S. Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B. C., is made commander of the Order of the British Empire.

AT the annual meeting of the British Mathematical Association, which was held in London on January 7 and 8, under the presidency of A. W. Siddons, the following were nominated for election as honorary members: Professor E. Borel, of the University of Paris; Professor G. H. Hardy, of the University of Cambridge; Professor David Eugene Smith, of Columbia University, and Professor E. T. Whittaker, of the University of Edinburgh.

DR. A. HAMILTON RICE, professor of geographical exploration and honorary curator of South American archeology and ethnology at Harvard University and president of the French Institute in the United States, has received the cross of the Legion of Honor from the French Government in recognition of his services for France during the war and his activities in the field of science.

A PORTRAIT of Dr. Charles H. LaWall, dean of the Philadelphia College of Pharmacy and Science, was presented to the college on December 5, by the artist, Leon A. Spielman, a graduate of the school and a practicing pharmacist.

DR. WILLIAM H. PARK, head of the Bureau of Laboratories of the New York City Health Department, observed his seventy-first birthday on December 30.

IN recognition of his work in soil science, the jubilee of Professor W. R. Williams, of the Timiriaseff Agricultural Academy at Moscow, was celebrated on December 20 by the Academy of Agricultural Science at Leningrad.

THE Karl Sudhoff medal has been awarded by the German Society of the History of Medicine, Natural Sciences and Technique to Professor T. Györy, professor of the history of medicine in the University of Budapest.

THE degree of doctor *honoris causa* of the University of Paris was recently conferred on M. C. E. Guillaume, director of the International Bureau of Weights and Measures at Sèvres.

ACCORDING to *Nature*, Sir Arthur Evans, at a meeting of friends and colleagues on December 17 held at the Society of Antiquaries, was presented with a portrait bust of himself in marble in recognition of his services to archeology, and in commemoration of the completion, in a fourth and final volume, of his work on the excavation of the Minoan site of Knossos in Crete. The bust is the work of Mr. David Evans, a former Rome scholar in sculpture. It represents Sir Arthur in academic robes and wearing the medal of the Society of Antiquaries, of which he was the first recipient. Lord Rennell presided, and Professor

R. M. Dawkins recounted the more notable achievements of Sir Arthur's career.

FRIEDRICH PASCHEN, the German spectroscopist, will celebrate his seventieth birthday on January 24. A correspondent writes: "Professor Paschen has spent most of his scientific life in Tübingen, where he became the teacher of numerous outstanding spectroscopists throughout the world. In 1925, he became president of the Physikalisch Technische Reichsanstalt. Paschen's infra-red hydrogen series, his discovery of the relativistic hyperfine structure of the hydrogen lines, his magnetic transformation effect in collaboration with Back, and his studies on the complex spectra of helium and other rare gases laid the background for the great development of the atomic theory from Niels Bohr to Sommerfeld, Landé, Goudsmit, Uhlenbeck, and others. His relativistic H-lines became one of the most convincing proofs of Einstein's theory. It may be mentioned, also, that Pauli found his exclusion principle working late one night in Tübingen after a careful study of one of Paschen's spectra. In 1933 Dr. Paschen retired from his office to devote himself to his favorite spectroscopic problems."

THE Botanical Society of America, at its twenty-ninth annual meeting in Pittsburgh on December 27, 28 and 29, elected as corresponding members the following botanists: Sir David Prain, lately director of the Royal Botanic Gardens, Kew; Dr. G. Haberlandt, emeritus professor of botany, University of Berlin, and Dr. Alvar Palmgren, professor of botany, University of Helsinki. The following officers were elected: *President,* Dr. Aven Nelson, University of Wyoming; *Vice-president,* Dr. K. M. Wiegand, Cornell University. Other officers of the society are: *Secretary,* Loren C. Petry, Cornell University; *Treasurer,* H. A. Gleason, the New York Botanical Garden. Officers of the sections of the society, elected or announced at the same meeting, are: Physiological Section, *Chairman,* S. H. Eckerson, Boyce Thompson Institute; *Secretary,* E. F. Hopkins, Cornell University; Systematic Section, *Chairman,* J. M. Greenman, Missouri Botanical Garden.

THE American Anthropological Association at its annual meeting at Pittsburgh elected the following officers: *President,* Robert H. Lowie, University of California; *First Vice-president,* Nels C. Nelson, American Museum of Natural History; *Second Vice-president,* Matthew Stirling, Bureau of American Ethnology; *Secretary,* John M. Cooper, Catholic University of America; *Treasurer,* C. B. Osgood, Yale University; *Editor,* Leslie Spier, Yale University; *Associate Editors,* C. B. Osgood, Yale University; Frank G. Speck, University of Pennsylvania; F. H. H. Roberts, Jr., Bureau of American Ethnology; M. J. Herskovits, Northwestern University; *Executive Committee,* W. D. Wallis, University of Minnesota; Fay-Cooper Cole, University of Chicago; Carl E. Guthe, University of Michigan.

AT the annual meeting of the Association for Research in Nervous and Mental Diseases, Dr. Edwin G. Zabriskie, of the Neurological Institute of New York, was elected president to succeed Dr. Lewellys F. Barker, of the Johns Hopkins University Hospital. Dr. Charles H. Frazier, of University Hospital, Philadelphia, was elected first vice-president; Dr. Thomas K. Davis, second vice-president; Dr. Angus M. Frantz, secretary-treasurer, and Dr. Clarence C. Hare, assistant secretary.

THE Royal Astronomical Society of Canada elected officers for 1935 at the annual meeting held at the University of Toronto on January 8. The Honorable Dr. Leonard J. Simpson, minister of education for Ontario, was elected honorary president. Dr. Lachlan Gilchrist, professor of geophysics in the University of Toronto, was returned to the president's chair for a second term. Vice-presidents elected were: Dr. Ralph E. DeLury, Dominion Observatory, Ottawa, and Dr. J. A. Pearce, Dominion Astrophysical Observatory, Victoria. R. A. Gray, Toronto, was reelected general secretary and librarian, and J. H. Horning, general treasurer.

Nature reports that Sir Isidore Salmon, chairman and managing director of Messrs. J. Lyons and Company, Ltd., has been elected president of the British Decimal Association, in succession to Lord Hirst.

DR. MACGREGOR SKENE, reader in botany at the University of Bristol, has been appointed Melville Wills professor of botany in succession to the late Professor O. V. Darbishire.

DR. HUGH C. MCPHEE, who has been in charge of investigations in genetics in the division of animal husbandry of the Bureau of Animal Industry, U. S. Department of Agriculture, for the past eight years, has been appointed chief of the division.

DR. RICHARD P. STRONG, professor of tropical medicine at the Harvard Medical School, has been named a member of the board of trustees of the Carnegie Institution of Washington.

DR. JOHN M. T. FINNEY, professor emeritus of surgery of the Johns Hopkins University School of Medicine, has been appointed a consultant to the Baltimore City Health Department.

THOMAS ROWATT has been appointed director of the Royal Scottish Museum, Edinburgh, in succession to the late E. Ward.

DR. JOHN BURDON SANDERSON HALDANE, professor of genetics in the University of London, arrived in New York on January 1. He will give series of lectures at Columbia University, at the New School for Social Research, and in Chicago. The general subject of these lectures will be "The Popularization of Human Biology."

THE fourth Harvey Lecture will be given by Dr. Alfred N. Richards, professor of pharmacology at the University of Pennsylvania, on "Processes of Urine Formation in the Amphibian Kidney" at the New York Academy of Medicine on January 17 at 8:30 P. M. The fifth lecture, on February 2, will be given by Dr. E. C. Dodds, director of the Courthauld Biochemical Laboratory of the Middlesex Hospital, London, on "Specificity in Relation to Hormone and Other Biological Reactions."

DR. CHAUNCEY D. LEAKE, professor of pharmacology of the Medical School of the University of California, delivered the annual Phi Beta Pi Lecture on November 6 at the School of Medicine of Vanderbilt University.

DR. HARLOW SHAPLEY, Paine professor of practical astronomy and director of the Harvard College Observatory, spoke at recent meetings of the Harvard Club of Lowell, the Harvard Club of Cleveland and the Harvard Club of New York City. Dr. Edwin B. Wilson, professor of vital statistics at the Harvard School of Public Health, also spoke at the Cleveland meeting. On January 12, Professor Shapley will deliver a public address in Milwaukee, under the auspices of the local Harvard Club, and on January 14 will address a meeting of the Harvard Club of Chicago.

DURING the week of December 10 Professor R. Adams Dutcher, of the department of agricultural and biological chemistry of the Pennsylvania State College, addressed sections of the American Chemical Society at Dayton and Cincinnati, Ohio; Lafayette and Indianapolis, Indiana, and Lexington, Kentucky. His lectures dealt with "Some Impressions of Biochemical Research Work in Germany and Neighboring Countries."

DR. LACHLAN GILCHRIST, professor of geophysics in the University of Toronto, will deliver the presidential address before the annual conversazione of the Royal Astronomical Society of Canada which will be held in the McLennan Physics Laboratory of the university on Tuesday evening, January 15. He will speak on "Physics in the Service of Astronomy." At the same meeting experiments demonstrating the use of physics in astronomical fields will be conducted by Dr. R. K. Young, of the Dunlap Observatory, and members of the staff of the departments of physics and astronomy of the University of Toronto.

THE first International Congress on Gastro-Enterology is being planned for August 8, 9 and 10, at Brussels, Belgium, under the presidency of Dr. J. Schoemaker, The Hague. The secretary general is Dr. George Brohee, Rue de la Concorde, 64, Brussels. Dr. Max Einhorn, New York, is forming an American committee, of which he is chairman and Dr. DeWitt Stetten, New York, secretary.

THE tenth International Congress of the History of Medicine will be held at Madrid from September 23 to 29, under the presidency of Professor Gregor Marañon.

As previously announced, the fifteenth International Physiological Congress will take place in Leningrad and Moscow from August 9 to 17, under the presidency of Professor Ivan P. Pavlov. A reception will be held in Leningrad on the evening of August 8, to be followed by plenary and sectional meetings during the next eight days. On the night of August 16 members will travel to Moscow where, on the following day, further plenary and scientific sessions will be held and also the closing assembly of the congress. The Soviet committee in connection with Intourist Company, the travel company of the U. S. S. R., has arranged to provide transportation, meals and lodging in the Soviet Union at considerably reduced rates to members of the congress. All applicants from the United States and Canada are requested to communicate with the Arrangements Committee of the Fifteenth International Physiological Congress, in care of Intourist, Inc., 545 Fifth Avenue, New York, N. Y., for a booklet giving details of the arrangements and the various tours, costs, etc., and an application blank. All persons, other than members of the Federation of American Societies of Experimental Biology, interested in attending the congress as members, will be passed for eligibility after their applications have been submitted to the arrangements committee. Approved delegates will receive an admission card to the congress together with the Intourist travel orders. Those accepted as members of the congress will be entitled to special rates. Others wishing to attend as observers may do so by purchasing regular Intourist services, information concerning which may be obtained from local travel agents.

THE seventy-fifth anniversary of the foundation of the Liverpool Geological Society, as reported in *Nature*, was marked by a scientific conversazione, under the presidency of Dr. R. G. Wills, held on December 11 in the department of geology of the University of Liverpool. The assembly commenced with the reading of the minutes of the first ordinary meeting of the

society in 1859, after which the society's Medal was presented to Mr. Emil Montag, Swiss consul in Liverpool, for services rendered to the society during his twenty-four years' active membership, his editorship, his contributions to British and Swiss geology and his work in providing facilities for study in Switzerland. Professor H. H. Read, Herdman professor of geology in the University of Liverpool, vice-president of the society, then delivered a short lecture on earthquakes, followed by a demonstration of the university seismograph. Dr. E. Neaverson lectured on paleontological exhibits, and there was a demonstration of rock-cutting and of new maps. Amongst the exhibits was a collection of fossils, new instruments and minerals, the latter including specimens of two new British minerals recently found in Scotland; chondrodite, found in association with metamorphic limestone, and stichite, found in association with ultra-basic rocks.

LEGISLATION to enable the dairy industry of California to make and enforce marketing agreements in the state, is to be proposed in the forthcoming session of the legislature by the Dairy Control Legislative Committee, of which W. J. Kuhrt, of Los Angeles, is chairman. To prepare the proposed laws, an advisory drafting committee has been named, with F. H. Abbott, of the dairy industry division of the University of California at the Branch of the College of Agriculture, as chairman. Other members of the committee are: A. A. Brock, director of the State Department of Agriculture; F. T. Robson, chairman of the California Farm Bureau Dairy Department; G. E. Gordon, dairy specialist of the University's Agricultural Extension Service; M. R. Benedict, acting director of the Giannini Foundation of the College of Agriculture; J. H. Kagler, of the California Milk Institute; Stewart Westover, of the Evaporated Milk Agreement, and J. W. Pauluchi, dairy producer. The bill will be prepared in two parts, one covering market milk and the second covering the various other dairy products. It will be based on consumers' areas, rather than on production.

DISCUSSION

THE NATURE OF ENZYMES

I AM obliged to Professor James B. Sumner[1] for concluding his criticism of my note on "Enzymes, Vitamins, and the Zone of Maximum Colloidality"[2] with reference to the subsequent paper of H. Theorell,[3] for this is confirmation and extension of the experimental evidence (though Dr. Sumner says none exists) favoring the possibility (suggested by me but considered improbable by Dr. Sumner) that excessive kinetic activity might be a factor in reducing enzyme efficiency. Those familiar with the ultramicroscopic behavior of particles of colloidal dimensions (including enzymes) realize that when flavine/protein complexes are split, the higher particulate activity of the fragments might be a factor tending to reduction of enzymic action. This does not, of course, exclude the operation of other factors which I mentioned as basic, *e.g.*, the annihilation of, or unfavorable orientation of specific electronic areas.

Similar failure to understand physico-chemical factors appears in Dr. Sumner's attack[4] on the carrier or *Träger* theory of Willstätter. Deprecating the analogy drawn by Waldschmidt-Leitz[5] between "one of our best known proteins, namely hemoglobin," and catalase, Dr. Sumner states: "If the carrier acted merely as a protective colloid, then hematin suspended in almost any lyophylic colloid should possess high catalase activity; such, however, is not the case." Here Dr. Sumner has bludgeoned a straw man and shown himself oblivious to the vital factor of molecular orientation, developed in the researches of W. B. Hardy, I. Langmuir, W. D. Harkins, N. K. Adam and many others.[6] It is well known that many colloidal protectors inhibit catalytic action. Only such carriers can be effective as hold a prosthetic group in proper orientation, and/or serve to form or complete a specific electronic area.

Willstätter[7] has recently proposed the term *"symplex"* for compounds where high-molecular substances are bound by residual valencies—*e.g.*, a prosthetic group and a high-molecular carrier. Symplexes are distinguished from mere mixtures by one or more of the following characteristics: (1) alteration or enhancement of specific reactivity of one component; (2) change in solubility or dispersion of one component; (3) change in optical properties; (4) change in stability; (5) change in toxicity; (6) change in reactions, *e.g.*, color reactions. Among the symplexes discussed are enzyme compounds with substrates, activators, inhibitors and adsorbents; toxin-antitoxin; hemoglobin; and O. Warburg's oxidation enzyme (which was considered by Theorell[3] and by me.[2]

[1] SCIENCE, 80: 429, 1934.
[2] SCIENCE, 80: 79, 1934.
[3] *Biochem. Zeit.*, 272: 155, 1934.
[4] SCIENCE, 78: 335, 1933.
[5] SCIENCE, 78: 189, 1933.

[6] Early in this century Devaux (see review in Smithsonian Annual Reports, 1913) showed that if a lens of fatty acid is allowed to chill on water and is then carefully dried, the air/acid interface repels water, whereas the water/acid interface can be wetted.

[7] Willstätter and Rohdewald, *Zeits. physiol. Chem.*, 225: 103–24, 1934. G. Bredig (*Biochem. Zeit.*, 250: 414, 1932), by adding amino groups to fibers (cellulose, wool, silk), produced catalysts which split off CO_2 from bromcamphocarbonic acid.

Close association of particles, whether considered as "chemical" or "physical," is naturally followed by changes in kinetics and surface specificities Professor Hugh Taylor (Princeton) has shown that with many catalysts activity is mainly due to a relatively small number of very highly efficient minute areas

Apparently Dr Sumner[1] quoted Theorell's paper because it reports the *crystallization* of the oxidation enzyme Assuming that activity is not due to an adsorbed impurity, crystallization of a substance is no evidence whatever that the same substance may not form a colloidal dispersion For many years, teachers, writers and texts have perpetuated the erroneous notion that if a substance crystallizes it can not be a colloid, despite the fact that Thomas Graham, in his pioneer papers, clearly pointed out that the same substance (*e g* silica) may exist either in crystalloidal or in colloidal form We now know that *colloidal particles may be crystalline*[8] Graham stated 'The inquiry suggests itself whether the colloid molecule may not be constituted by the grouping together of a number of smaller crystalloid molecules, and whether the basis of colloidality may not really be this composite character of the molecule"

There is no lack of evidence that enzymes are colloidal when in active dispersion An interesting sidelight on the states bordering on crystallinity has just been thrown by Astbury and Lomax[9] by their x ray studies of the interaction of water and proteins including pepsin and trypsin Furthermore, Svedberg's ultra-centrifugal researches show how protein molecules form groups of varied size, kinetics and external residual fields of force, depending on conditions And I must repeat At the lower range of the colloidal zone, we have a reconciliation between the chemical and colloidal aspects of living matter'—even if Dr Sumner refuses to be reconciled Scientists should not attempt to force nature into a stoichiometric strait jacket

JEROME ALEXANDER

[8] See, *e g*, P Scherrer, *Nachr Ges Wissen* Goettingen, 96, 1918

[9] See *Chemistry and Industry*, November 16, 1934, report of Manchester meeting, on November 10, of the Chemical Society

THE DENSITY OF WATER IN RELATION TO ITS THERMAL HISTORY

THERE has recently been accumulated a considerable body of experimental data[1] which is now being interpreted on the assumption that water which has shortly before been ice (called ice water) has an internal structure different from water which has shortly before been steam (called steam water) It is postulated that ice water at a definite temperature contains a greater proportion of the polymerized or bulky molecules of water than does steam water at the same temperature, this difference in extent of polymerization gradually decreasing with time until both the ice water and steam water become identical

It has occurred to us that an unambiguous test of these assumptions could be made by measuring the density of ice water and steam water by the methods which we have been using in connection with another research[2] Since 'trihydrol" is supposed to have a density of 0 88 and 'dihydrol"[3] 1 08942, and since we can measure relative densities with an error not greater than one part per million (p p m), it is evident that we should be able to detect a slight difference in the percentage of trihydrol A study of the densities of ice and steam water was chosen for the reason that the presence of impurities would increase the density of water, whereas the presence of a greater proportion of the trihydrol would decrease the density of water

Ordinary laboratory distilled water was redistilled from alkaline permanganate and the temperature of floating equilibrium of the totally immersed float measured at 23° C Without removing the water from the cylinder, approximately four fifths of the water was frozen, then remelted and the temperature of floating equilibrium again determined as quickly as possible The temperature was exactly the same as before, therefore, the freezing and melting of the water and ice produced no detectable change in the internal structure of the water The final temperature was measured within an hour from the time that the ice melted and a significant change in density could have been detected within half an hour It is believed by some, however, that large block commercial ice on melting gives more trihydrol than does ice made from laboratory distilled water Accordingly, we melted two selected blocks of clear commercial ice and within an hour from complete melting again measured the temperature of floating equilibrium The temperature this time was higher than the two previous measurements by 0 010° C which indicates that this ice water has a greater density than highly purified water to the extent of 2 4 p p m Again there was no indication of an enhanced percentage of 'trihydrol' of the ice water as compared to steam water We conclude that the biologists and others should explain their data on hypotheses different from the hypothesis of a greater trihydrol content of ice water

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[1] For a recent complete bibliography and discussion see T C Barnes and T L Jahn, *Quart. Rev Biol.*, 9 292, 1934.

[2] M Dole, *Jour Chem. Phys*, 2: 337, 1934

[3] See note 1.

PLOUGHING UNDER THE SCIENCE CROP

IT is possible that Dr. Campbell in his recent address[1] has begged the question. The "small group of extremists" whom he mentions, advocate, not "the taking of a holiday in scientific research," but a slowing up of research efforts in order that there may be time to discover, not new things, but the meaning of things already discovered. To some the physicist and the chemist seem to be traveling so fast as not to heed or care where or how or why they are going. Nor do they heed or care what misapplications are made of their discoveries.

Indeed, not only in industrial scientific laboratories but also in some, at least, of the laboratories connected with educational institutions, the chief aim of scientific research is to enable those who already receive an undue share of the wealth produced by industry and research, to appropriate a share still larger. And there is a constant and increasing demand from educational institutions for more funds to be used by their scientific laboratories for more research for more applications for more profits for more segregation of wealth.

Is it not time to remember that there are other sciences, psychology, economics, sociology, upon the development of which the welfare of mankind depends far more than upon the development of physics and chemistry? And to remember that the development of that group of humane sciences would serve to prevent the misapplication of the discoveries of the physical sciences to the hurt, the destruction, the degradation of mankind?

Physics and chemistry boast of the improvement in man's material welfare brought about by their discoveries. True; but for thousands who are so benefited there are millions who are not, because of the distribution of wealth. These can not have even the material benefits of physical science because they can not afford to pay for them. Psychology, economics, sociology, philosophy, if adequately endowed, could alleviate these evils; could, possibly, eliminate them.

The "small group of extremists" demands a readjustment, a realignment, a redistribution of "research" and of "progress," so that man's progress shall be that of a man, not that of an octopus stretching out first one arm, then another; shall be a homogeneous progress of society as a whole; shall be a progress, material to be sure, but to an even greater degree spiritual. These are the things which the "small group" of enthusiasts, idealists demand, even if physics and chemistry must, therefore, for a time be dormant. Perhaps a "rest period" would greatly benefit those sciences themselves.

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[1] SCIENCE, 80: 2085, December 14, 1934.

QUOTATIONS

SCIENCE IN THE NEWS

IN the remarks preliminary to his recent address on cosmic rays Dr. Robert A. Millikan expressed some views about newspapers, his fellow-scientists and the present generation. It is almost inevitable, he said, that any new field in which there are many workers should appear to the public, and even to many of the workers themselves, to be in a state of hopeless confusion. This, he thought, is because the individual workers, unrestrained in a new field by a body of established fact, tend to set up hypotheses that seem to fit their particular experiments or their particular theories, and are themselves ignorant of, or at least incredulous about, the findings of others, so that "the public soon loses itself in a maze of incompletely understood and apparently contradictory statements and opinions, and knows not whom and what to believe." This situation, he continued, "is not improved by the existence of the daily newspaper, which, as its very name implies, is under a greater pressure to find for its pages something that is new rather than something that is true." He ventured the prediction that the present age, because of "its craze for the new regardless of the true," will be looked back upon by our grandchildren with "amazement and ridicule."

It is unusual to hear the daily newspapers criticized for printing too much news about science. The more common criticism is that they devote a disproportionate space to scandals, murders and sports, and neglect the world's constructive cultural achievements. Dr. Millikan's criticism serves to direct attention to the increasing amount of attention that the newspapers have been devoting to science, which implies a growing interest in science on the part of their readers.

Dr. Millikan ought to be the last man to deplore such a development. His statements seem to indicate that he does not believe that the newspapers ought to confuse their readers by printing news about controversial hypotheses, but this is to imply either that the newspapers should themselves set up as judges of the truth of scientific theories, refusing to print anything about new theories that they did not agree with, or that they should not print any scientific news until it had got past the controversial stage. It would be very difficult to say when this point had been reached, if it ever was, and the probable result would be to cut

down scientific news to the merest fraction of the present amount, or to print only such things as the multiplication table.

Dr. Millikan's own definition is that an opinion becomes established in physics "when nine-tenths of the informed and competent workers in the field are in agreement upon it," and adds that there will always be a certain percentage of people who will vote "no," and that "for no reason whatever except that they are built that way." The newspaper, however, can hardly be expected to stop to take a census before it publishes anything about a scientific theory or discovery. If it did so it would not only abandon its primary function of informing the world—including the scientists themselves—of the discovery, but it would be shutting off the views of the dissenting 10 per cent., and the history of science certainly does not show that this dissenting 10 per cent. has always been wrong.

The function of the newspaper is primarily to report what the leading scientists do and say. If they contradict each other, and there is confusion, the newspapers merely picture the confusion and do not create it. To the extent, however, that newspaper reports emphasize the contradictions among scientific theories, they increase the pressure on the scientists to eliminate these contradictions.—*The New York Times.*

SCIENTIFIC BOOKS

THE ARCHITECTURE OF THE UNIVERSE

The Architecture of the Universe. By W. F. G. SWANN. ix + 428 pp. The Macmillan Company, 1934. $3.75.

ALTHOUGH "The Architecture of the Universe" is somewhat similar in subject-matter to several other books that have appeared in recent years, it is a refreshing and original work. Its twelve chapters are devoted to such subjects as the nature of matter, modern atomic theories, space and time, dimensions, the restricted and general theories of relativity, vital processes and science and theology. The author does not presuppose extensive scientific training on the part of his readers, and consequently refrains from using the technical language of the specialist, yet he goes deeply into the fundamentals of each of the subjects he treats. Indeed, I have read no other semi-popular discussion of these subjects that presents them so adequately and satisfactorily.

In style, the book of Dr. Swann is quite different from others in its field. There is in it no striving for the sensational, no parading of the paradoxical, no mixing in of the mystical. Instead, with refreshing balance and candor, the author presents science as a sane, orderly body of doctrine developed for interpreting experience. Science as he presents it has the fine spirit we associate with the names of Archimedes, Galileo, Newton and Darwin. I can not easily over-emphasize the excellence of these praiseworthy qualities of his exposition. But in mentioning them I am likely to convey the impression that the book may be dull and monotonous. As a matter of fact, it is sparkling with wit and humor, extraordinarily rich in figures of speech and extended comparisons, and livened with many fine passages. The extended comparisons or parables are not only apt but often very interesting. If they have a fault, it is that in some cases they are so long and so entertaining that the reader is likely to forget that they are only illustrations of an important and difficult scientific principle or conclusion. An example is the parable used in discussing the second law of thermodynamics.

The author has attained exceptional sparkle and variety of exposition by a remarkably successful use of an interesting device. He often sets up a discussion between himself and the reader, all expressed in direct quotations. Under this method he does not limit himself to stating his own conclusions; the reader, too, expresses his opinions, his misconceptions, doubts and antagonisms, and the author answers him. This method, of course, is not new, for it was employed by Plato and Galileo and many other writers. But Dr. Swann has used it with rare skill, being eminently fair in permitting the reader to have his say and equally fair in his replies, and illuminating all with wit and apt figures of speech.

It is not possible within the limits of space available for a review of the book to outline comprehensibly any of the particular discussions Dr. Swann has given. I must content myself with saying that his remarks upon the second law of thermodynamics, the principle of indetermination, vital processes and even the relationship between science and theology are particularly penetrating, balanced and convincing. If any of these subjects were to be omitted, I should choose the last, partly because from its nature it does not lend itself to very definite conclusions. The author does not, however, indulge in any such amateurish attempts to rest theology on science as have frequently appeared in recent years.

"The Architecture of the Universe" is a splendid book which I strongly recommend to those who desire to get a real understanding of the heart of science to-day and who are willing to devote considerable careful thought to attaining that goal.

F. R. MOULTON

A STUDY OF SUPERSTITION

Do You Believe It? By OTIS W. CALDWELL and GERHARD E. LUNDEEN. 307 pp. Doubleday, Doran and Company. 1934. $3.00.

THIS meritorious volume has a divided purpose. The one is to present a general survey of superstitions as they come down through the ages, are modified and revived, together with some account of the origins of these persistent beliefs and the habit of mind, the quality of reasoning behind them. The other is to investigate the present prevalence of beliefs in superstitions and their effect upon behavior; and in view of the finding to suggest some educational measures to counteract this incongruous and somewhat weakening trend. The two purposes are not altogether consistent, nor can they follow the same treatment and style. The reader interested in the popular aspects will not follow the statistical account; and those who read it for its more serious purpose have no need to enlarge their acquaintance with popular misconceptions.

The general survey does not go sufficiently behind the scenes to add to the philosophy of the topic; that is a far-flung inquiry in its own right. The survey includes false beliefs (such as weather signs) where there is some measure of scientific approach and also folk-lore as well as doctrinal superstitions in which this is lacking.

While these two orders of false thinking should be distinguished, it is convenient to have the two aspects assembled within one pair of covers; and this contribution by Dr. Caldwell and Mr. Lundeen serves the purpose well. It will give libraries just the book to which they can refer the general reader, who, if he reads it properly, will emerge from the exercise with a wiser view of the distinction between the cautious steps of science and the vaulting leaps of superstition, untroubled by the insecurity of premises. It makes a fine correction for the vagaries of popular belief.

The statistical study proceeds by the method of selecting 100 current superstitions and false beliefs and asking the subjects—in the initial series about 700 junior high-school pupils—to indicate whether they hold this belief or do not, whether they heed it or not in their behavior. The general result, that on the average, these students approve or assent to or are affected by as many as 22 such superstitions, indicates a rather formidable hold of false beliefs in the formative educational years. The superstitious tendency diminishes somewhat with maturity; girls are uniformly more hospitable to such beliefs than boys; the more intelligent entertain fewer superstitions than the less intelligent; the contagion of belief among friends, home and immediate surroundings is the dominant factor in their spread. Introducing corrective training in the general principles of cause and effect, as illustrated in the sciences, definitely reduces the inclination toward superstitious beliefs.

These general results, for the most part readily anticipated, are about all that the statistical method can yield. They supply a somewhat objective set of data, but do not, perhaps can not, attain any greater significance. It is true of this, as of many another painstaking study in the less concrete realms of educational psychology, that their yield is small compared to the expenditure of mental energy involved. The essence of such a problem as the spread and hold of superstitions lies in the qualitative analysis of the habit of mind conducive to their acceptance. This disappears in the mass statistics, in one respect needlessly so. Crude superstitions and false generalizations are treated as one. If separated, as they could readily be, and if furthermore within the superstitious field the more venial instances were separated from the grosser violations of logic, a step or two might be taken toward an index of superstitiousness. A comparison of the ten most generally accepted with the ten most generally rejected gives the impression—despite a rather scattered distribution—that these young ideas, which are trying to shoot straight, are mostly given to the lighter types of illogicalities.

The literature of superstition has been mainly one of anthropological interest when serious, of folk-lore curiosity when in popular vein. The psychological interest forms a chapter in the comprehensive story of how the human mind groped, stumbled, drifted, fumbled in its haphazard course in learning how to think. The conflict of psychological trends with logical precepts, pointedly illustrated in wish-thinking, explains part of it; the intrinsic difficulty of the technique outside the familiar range of events accounts for another phase. Scientific thinking does not come naturally to the popular mind; those professionally devoted to its dissemination have gone through a discipline to attain their expertness.

JOSEPH JASTROW

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE GEAR PUMP AND HOSE AS A COLLECTOR OF WATER SAMPLES FOR GAS ANALYSIS

IN our study of the gaseous content of the waters of Chesapeake Bay and its tributaries, in connection with a biological survey, it is often necessary to take samples from a depth of 25 meters or more where the water is under much greater pressure than at the surface. It is generally known that when such samples reach the surface there is a tendency for the contained

gases to pass from the water to the atmosphere if the water is exposed. Those who have studied the gas content of samples of natural waters are agreed that precautions must be taken to protect the samples in some way if accurate analyses are to be made.

However, a review of the literature indicates that most workers have not paid much attention to the loss of gases resulting from bringing deep-water samples to the surface. It is true that Krogh,[1] using a bottle for the collection; B. Helland-Hansen,[2] discussing the use of a pump and hose; Buch and Grippenberg[3] and others state that the loss of gases is negligible. We believed that this might be the case ordinarily, but since we wanted to use the convenient pump and hose method in an extensive series of analyses for gases in water we felt it necessary to compare samples collected in this way with those collected by an apparatus where there could be no loss.

The apparatus used was constructed as described below. A 250 cc glass tonometer (Fig. 1), such as

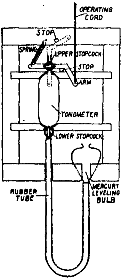

FIG. 1

the one used by Van Slyke in his gas studies, was mounted in a wooden frame of 2″ x 4″ material in such a manner that it was held in position vertically about midway in the frame. One end of the tonometer, with both stopcocks open, was connected by a heavy walled rubber tubing to a 500 cc mercury leveling bulb. The latter was slotted into the base of the frame so that it could be easily removed and replaced. About 500 cc of mercury was then poured into the mercury leveling bulb and the bulb was raised until the tonometer was filled with mercury so that no air was present, even above the upper stopcock, which was then closed. Any gases which might have been in between the mercury and the glass walls were expelled by lowering the mercury leveling bulb several times so as to produce a partial vacuum in the tonometer and then manipulating the leveling bulb and the upper stopcock, the latter being left closed finally. The leveling bulb was then returned to its place in the base of the frame. In this way the tonometer was filled with gas-free mercury.

In order to fill the tonometer with a sample of air or of water all that is necessary is to open the upper stopcock. The mercury in the tonometer then flows down through the tube into the leveling bulb in order to make the level of the mercury the same in both. When the mercury has run out of the tonometer the upper stopcock is closed. The result is a sample of air or water filling the tonometer and protected from escape above by a closed stopcock and from below by mercury.

In order to make the apparatus so that it could be opened at some considerable distance from the operator, *e.g.*, at a depth of 25 meters in the water, a metal arm was fastened to the upper stopcock. The arm was bent in such a way that a cord attached to the arm, as shown in Fig. 1 and pulled sufficiently, would rotate the stopcock through 90° and then stop. In order to close the stopcock, a stout coiled spring was attached to the other end of the arm and anchored to the top of the wooden frame. Thus the spring automatically closes the upper stopcock when the tension on the cord is released. To prevent the metal arm from moving through too wide an arc, a metal stop was placed on the top of the frame in such a position that when the arm had moved and had opened the stopcock, further rotation was prevented. Another stop was placed as shown in the figure, so that the arm would not move too far when the tension on the cord was released.

Since the apparatus just described was lowered along with the hose so that samples could be taken at the same time and depth with both the tonometer apparatus and the hose-pump apparatus it is necessary to describe the latter.

A 1-inch Oberdorfer bronze, gear pump driven by hand was used. In order to facilitate the taking of samples for different purposes, *i.e.*, for plankton and for chemical analysis, certain accessories were added. They were made of tinned brass so as to avoid chem-

[1] A. Krogh, *Meddelelser om Grønland*, xxvi: 341, 1904.

[2] B. Helland-Hansen, *Internationale Revue der gesamten Hydrobiologie und Hydrographie, Hydrographische Supplemente*, 1. Serie, 2 Heft, p. 16, 1912.

[3] K. Buch and S. Grippenberg, *Jour. du Conseil*, 7: 244, 1932.

ical interaction between the apparatus and the water samples. All the joints between the pump and the accessories were sweated shut, thus giving a continuous metallic surface. The accessories consisted of a tee, a pet cock, a gate valve, a 1-inch pipe and a piece of block tin tubing. One limb of the tee, the opening of which may be used for priming purposes, is stopped with a removable plug. After priming, the plug is tightly screwed in. A second limb was attached to the outflow opening of the pump, while the third limb with the gate valve in it served as the main outflow of water from the tee. The pet cock was sweated into the side of the third limb and the piece of block tin tubing, 12 inches long, was soldered on to the delivery end of the pet cock.

The intake end of the pump was attached to a hose reel by means of a 1-inch pipe and a ground brass swivel joint, which enables the operator to conveniently pay out as much hose as is needed and then by means of a wrench to readily make this joint leak-proof. The hose measured 1 inch inside diameter. It is necessary that all parts of the pump and its attachment to the hose should be leak-proof or serious errors will arise due to the sucking in of air.

In order to make the final preparations for the collecting of both kinds of samples at the same depth and time, the tonometer apparatus, assembled and adjusted as described above, was firmly wired to the hose alongside of its intake end. The end of the hose was weighted with 60 pounds of lead so that the hose would extend downward as nearly vertically as possible. The hose with lead and tonometer apparatus firmly wired to it at the intake end as described were then lowered to the desired depth, the operator paying out the cord with which the tonometer stopcock may be opened.

Both sets of apparatus are now ready for the collection of the sample. In the case of the tonometer the cord upon being drawn tight will open the upper stopcock and allow the water to enter, since the mercury held in the tonometer sinks in order to adjust its level to that in the leveling bulb, which is at a considerably lower level. A release of the tension on the string after 5 minutes allows the stopcock to be closed again by the spring and the sample is tightly enclosed in the tonometer.

In the case of the pump and hose apparatus, after priming and screwing in the priming plug, the pet cock connected with the block tin tube is closed, the gate valve is opened and the water pumped up until sufficient has flowed out to yield a sample which has its origin from 25 meters. The gate valve is then closed, the pet cock opened and a sample of water is delivered either under oil in a sample bottle or preferably into a tonometer such as the one used in the tonometer apparatus but without the rubber tubing, mercury and leveling bulb.

Samples of this sort, taken by the two methods, were then analyzed, within a short time, in the laboratory, using the manometric Van Slyke apparatus. The samples can be transferred to the Van Slyke apparatus without loss of gas if the usual methods in the operation of the apparatus are followed.

A comparison of the results obtained in an analysis of two samples collected by the methods outlined above are given in Table 1.

TABLE 1

	Total CO_2 p.p.m.	O_2 p.p.m.	N_2 p.p.m.
Pump	50.5	9.1	17.8
Tonometer	51.7	8.1	17.1

It will be noted that the difference in each case is about 1 part per million. Even this difference might have been due in part to the use of oil for the pump samples. Another pump sample gave closely similar results. Earlier work, however, in which less care was taken in making the pump and hose leak-proof gave a greater discrepancy in results. It is evident, however, that when the pump and hose are properly put together and properly handled the values obtained for the gases in the water samples taken will be sufficiently accurate for physiological purposes.

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METHIONINE AS AN IMPURITY IN NATURAL LEUCINE PREPARATIONS

IN recent experiments dealing with the effects of various amino-acids in the growth of the diphtheria bacillus, differences have been found in the action of l-leucine preparations. It was recalled that in the early work on methionine considerable sulfur, probably as methionine, was always present in the crude "leucine fraction" of material obtained by concentrating protein hydrolysates. Two instances were also in mind of the occurrence of readily measurable amounts of sulfur in specially purified l-leucine, one of these, at least, prepared by the ester method.

Commercial l-leucine from three different manufacturers, two American and one German, were therefore examined. The two former gave strong qualitative tests for sulfur, and likewise a fairly heavy precipitate with $HgCl_2$. The latter gave only a weakly positive test for sulfur and very slight opalescence with $HgCl_2$. Quantitative sulfur determinations by Na_2O_2 fusion were as follows:

Specimen A 0.4000g gave 0.0471g $BaSO_4 = 7.5$ per cent. methionine

Specimen B 0.4018g gave 0.0573g $BaSO_4 = 9.2$ per cent. methionine

Specimen C 0.4000g gave 0.0179g $BaSO_4 = 2.7$ per cent. methionine

These three specimens were further examined as to their effect on the growth of a strain of diphtheria bacillus which requires methionine for optimal development. A control solution,[1] containing all the ingredients for growth except methionine, was prepared and additions to equal amounts were made as indicated in the table. The solutions were made up to a volume of 10 cc, adjusted to pH 7.6, and sterilized. Total nitrogens, taken as a comparative measure of the amount of growth, were made on the centrifuged and washed diphtheria bacilli growing at 35° in 60 hours on these media. The results are shown in the last column of Table I.

TABLE I

	Media			Mg N in bacterial growth
1	Control + l-leucine	A	10 mg	0.83
2	" + "	B	10 mg	1.44
3	" + "	C	10 mg	0.48
4	" + dl "	(synthetic)	10 mg	0.30
5	" + dl methionine		1.0 mg	1.80
6	"			0.35

It is therefore evident that methionine in considerable amounts may be present in commercial leucine preparations and that failure to recognize this fact may lead to complications where such material is used in biological experiment.

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SPECIAL ARTICLES

ELECTRICAL POTENTIALS FROM THE INTACT HUMAN BRAIN[1]

DR. HANS BERGER, of Jena, has published a series of papers in which he reports that changes in electrical potential which are correlated with human brain activity may be magnified and recorded by the use of a suitable vacuum-tube amplifying system and an oscillograph.[2] These potential changes are obtained from needle or surface electrodes placed on different points of the head. His most typical electrode arrangement is one in which needle electrodes are inserted through the skin to the periosteum, one in the back of the head to the right of the median plane and the other high on the forehead to the left of the median plane. He reports, however, that electrodes placed on the surface of the skin give results comparable to those secured by the use of needle electrodes. He holds that the records secured by the use of this general technique show, among other phenomena, two characteristic forms of rhythmic electrical oscillations. The waves of greatest magnitude he calls alpha waves. Smaller oscillations which are sometimes observed alone and sometimes as superimposed upon the alpha waves he calls beta waves. The alpha waves occur with varying frequency in normal adults, but about 10 cycles per second may be taken as a typical value. These waves may show a potential of as much as 100 to 200 microvolts when needle electrodes are used. The beta waves have a frequency of about 25 cycles per second and have a magnitude much less than that of typical alpha waves.

Berger has carried out control experiments intended to demonstrate that the electrical phenomena which he is studying are functions of brain activity and not of some other organic process. Simultaneous electroencephalograms (as he calls the records of the electrical phenomena which he considers to be correlated with brain activity) and electrocardiograms have been taken. These records demonstrate the fact that there is no direct relationship between the so-called brain waves and the pulse. Moreover, even a momentary arrest of both breathing and heart beat had no marked effect on the brain potentials. In the course of human brain surgery it has been possible for him to place electrodes directly on the brain through trephine openings. The records so taken are similar to those secured by the use of the surface electrodes. Prawdicz Neminski[3] has secured similar action potentials from electrodes on the brain of dogs, that is, waves of large magnitude at a frequency of 10 to 15 per second and smaller waves 20 to 32 per second. Adrian and Mathews[4] have recently observed similar phenomena originating in the cortex of the rabbit.

Dr. Berger has shown in these experiments that the alpha waves diminish in magnitude under certain types of anesthesia, during an epileptic seizure and, it may seem at first sight paradoxically, when the

[1] The control solution is fully described in an article now in press (*Jour. Bact.*).

[1] This research has been made possible by a grant from the Rockefeller Foundation.

[2] H. Berger, *Arch. f. Psychiat.*, 87: 527, 1929; 94: 16, 1931; 97: 6, 1932; 98: 231, 1933; 99: 555, 1933; 100: 301, 1933.

[3] P. Neminski, *Pflüg. Arch. f. d. ges. Physiol.*, 209: 362, 1925.

[4] E. D. Adrian and B. H. C. Mathews, *Jour. Physiol.*, 81: 440, 1934.

subject is given sensory stimulation or does a "mental" problem. The waves indeed appear at a maximum amplitude when the subject is relaxed. He has studied a variety of pathological cases and finds that marked changes in alpha waves are characteristic of certain abnormal brain conditions. The beta waves, however, seem, according to the report of this investigator, to remain very constant in most conditions of the organism. Dr. Berger presents an elaborate and interesting psychological discussion, couched largely in terms of an inhibition theory of attention, as an explanation for the results which he has secured. Adrian and Mathews, from their work on animals, are of the opinion that the low frequency waves are due to the summation of many smaller higher frequency potentials.

A brief statement of the technique and results of our present investigation, which has in some respects confirmed and amplified Berger's results, is given in the following paragraphs.

In most of our experiments electrodes made of silver disks 1 to 2 c in diameter, covered with flannel soaked in salt solution, are used. These electrodes are placed on the skin surface and usually at opposite poles of the head. For example, one may be placed high on the forehead and the other at the back of the head just above the inion. The electrical potentials appearing at these electrodes, when fed into a suitable amplifier-oscillograph system, confirm Berger's general observations. Notably our records show large rhythmic oscillations (alpha waves) which vary in magnitude from about 20 to 80 microvolts and in frequency from about 8 to 12 cycles per second in a normal adult during a favorable condition of relaxation and quiet. In one experiment simultaneous records were taken from a pair of needle electrodes inserted through the skin to the periosteum and from a pair of surface electrodes on the skin directly above. Using a pair of matched non-interfering amplifiers and oscillographs the two records were practically identical in form, although the potentials picked up by the needle electrodes were slightly greater.

Smaller oscillations (beta waves) are also observed at magnitudes of about 15 to 30 microvolts and with frequencies varying from 25 to 50 cycles per second. These small oscillations are quite variable in frequency and different in form from the larger alpha waves.

In addition to these potentials, which appear to be present across almost any part of the head during a quiet, relaxed state, what seems to be a different type of potential has been recorded when the subject is presented with a sensory stimulation such as a light or sound. In several instances electrodes seem to have been so placed on the head that following a given stimulation a complex series of waves appear which may possibly be thought of as the positive excitatory effect of the stimulus. Further experimentation may make it possible to identify these as excitation waves, since they resemble somewhat the action potentials taken from visual centers of animal brains following photic stimulation.

In addition to the potentials which have just been described, incidental potential shifts such as those caused by movement of the skin beneath the electrodes and short "spiked" waves of muscular action currents (about 10 σ duration) are at times recorded in the course of our experiments. These secondary phenomena are most noticeable when the subject is in a state of heightened muscular tonus or restlessness. These phenomena seem not to be present in a completely relaxed and cooperative subject who is comfortably placed in a quiet, dark room. It seems, however, that the skin and muscle potentials may be readily distinguished by their form and frequency from those potential changes which, according to Berger's theory, are to be considered as of brain origin. Similar potential changes observed by several investigators in carefully controlled experiments on animals suggest that these changes are of cortical origin.

Separate rooms for the subject and the apparatus, both well shielded against electrical disturbances, have been used in our experiments.

Fig. 1 illustrates the type of record which we have obtained from a relaxed and cooperative subject.

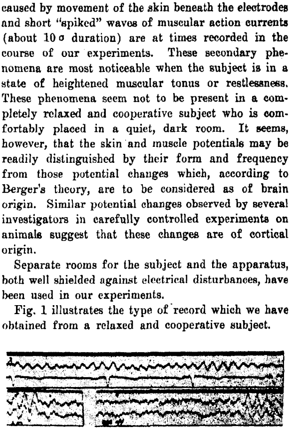

FIG. 1

The first record of Fig. 1 shows the alpha waves in the upper line and in the second line a record taken, as a control, simultaneously from electrodes placed across the left leg above the knee. A record of the pulse only is obtained in this latter curve and no relation is seen between the pulse and the simultaneously recorded alpha and beta waves.

"Spontaneous" fluctuations in magnitude of the alpha oscillations are present in all our records. When the subject is undisturbed by extraneous stimulation these fluctuations appear quite regularly at 1 to 2 second intervals. This rhythm may be seen in the sample record No. 1. We have been unable to correlate these fluctuations with any other organic rhythm. They are the type of modulations that would be produced by the interference of different component frequencies, the total effect of which we obtain

in our records. This provides indirect evidence in support of the hypothesis of Adrian and Mathews, namely, that the large oscillations are the end result of potentials built up by several smaller oscillations at different frequencies.

The second record shows two recordings of the effect of light stimulation on the large alpha waves. The two records are taken across different parts of the head. It will be noted that these waves are markedly reduced by the light stimulation after a latency of 0.4 seconds. (The time line at the top of the record indicates 1/50 second intervals. The signal indicating the period of stimulation is marked by an upward deflection of the time line). When the light stimulus is turned off, the alpha waves return to normal after a short period. The duration of this after-effect of light stimulation seems to vary with characteristics of the stimulus, such as duration. It may most tentatively be suggested that this latency in the return to normal of the alpha waves is possibly associated with the phenomenon of the visual after-image.

As noted above, it is suggested by Berger that the alpha waves may indicate a fundamental characteristic of brain activity. In our experiments on normal individuals the frequency varies little from day to day when experimental conditions are maintained constant. Characteristic frequency of different normal individuals has varied from about 8 to 12 cycles per second. In 6 individuals from whom repeated records were secured on different days, up to five repetitions, variation of not more than one cycle per second was shown in the same individual on successive measurements. In one or two pathological cases which we have studied a frequency of alpha waves as low as 2 or 3 per second has been observed. We have also demonstrated that in certain normal individuals when the electrodes are placed so as to include part of the right side of the head between one pair and part of the left side of the head between the other pair the same frequency is observed in both records and under these conditions the waves are typically in phase. Other records indicate that some normal individuals, and especially certain pathological cases, show different frequencies or a lack of synchronism between the functioning of one side of the brain and that of the other. For example, in the case of a young girl who suffers from a convulsive disorder and is quite ambidextrous, the alpha-wave frequency was observed on repeated tests to be about 10 per second across the left side of the head and but 6 to 8 cycles across the right side of the head. These records were taken simultaneously by the use of two well-matched, non-interfering amplifier-oscillograph systems.

In conclusion, we may say it has been possible for us to confirm many of Berger's observational findings. With the improvement of recording techniques and with an increased understanding of the functional relationship between the results secured and other processes of the living organism, it may well be that electroencephalograms of the sort described in this note may prove significant in psychology and clinical neurology. It is even possible that this technique may provide information in regard to brain action which will be comparable in significance to the information in regard to heart function which is provided by the electrocardiograph. Further experimental studies of the phenomena described here are in progress.

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THE LONG WAVE-LENGTH LIMIT OF PHOTOLETHAL ACTION IN THE ULTRA-VIOLET

SINCE the earliest observations on the lethal action of sunlight by Downes and Blunt in 1877,[1] the determination of the long wave-length limit of lethal action of light upon cells has been a subject of recurrent interest, as various investigators, failing to use a quantitative technique, claimed different limits. In 1924 Coblentz and Fulton,[2] measuring the incident intensities at different wave-lengths, showed that much less energy is necessary to kill *Bacillus coli communis* at wave-lengths shorter than 3,050A than at longer wave-lengths, although lethal action extended as far as 3,660A when the dosage was exceedingly large. Few studies on the wave-length limit of lethal action have been made upon protozoan cells. Swann and del Rosario[3] report that the wave-length 3,132A is only 1 to 4 per cent. as destructive to Euglena as is the wave-length 2,536A. On the other hand, Weinstein[4] reports that *Paramecium multimicronucleata* is killed about one ninth as readily at 3,130 as at 2,654A and about one half as readily as at 3,025A comparing the lethal action on the basis of the energy incident upon the exposure cell. As this appeared to be an unusually destructive effect for the wave-length 3,130A, it was decided to investigate its effects upon this species of Paramecium as well as upon several other protozoans.

The protozoans were obtained in sufficient numbers by inoculating individuals from a local pond into 0.1

1 Downes and Blunt, *Proc. Roy. Soc.*, 26: 488, 1877.

2 Coblentz and Fulton, *Sci. Papers U. S. Bur. Standards*, 19: 641, 1924.

3 Swann and del Rosario, *Jour. Franklin Inst.*, 213: 549, 1932.

4 Weinstein, *Jour. Op. Soc. Am.*, 20: 433, 1930.

per cent. lettuce infusion, buffered at a pH of 7.0 and incubated at 26° C. in a water bath. Rapid multiplication occurred. Paramecia were cultured in the controlled manner described in another paper.[5] The quartz mercury arc, the monochromator, thermopile, reaction cells, exposure chamber and the procedure followed have been described in another paper.[6] To insure purity of light at the wave-length 3,130A, a Cornu prism was used. Usually 50 or 100 animals were exposed at a time.

RESULTS

While *Stylonychia mytilus* and *Euplotes patella* did not become vesiculated at 3,025A (average intensity for all experiments at this wave-length: 22 ergs/mm^2/sec.) until a dosage of 66,000 ergs/mm^2 at the midpoint of the exposure cell had been given, *Paramecium multimicronucleata* became vesiculated after a dosage of about 33,000. A dosage of only 16,500 ergs/mm^2 is sufficient to kill the Paramecia after a lapse of 24 hours following irradiation. A dosage of about 9,300 ergs/mm^2 kills only a few Paramecia even after a lapse of 24 hours. Since the area of a Paramecium exposed is about 0.0106 mm^2 the energy incident upon a single Paramecium is the energy per mm$^2 \times 0.0106$.

On the other hand, even if many times the above dosages of energy at the wave-length 3,130A (average intensity: 40 ergs/mm^2/sec.) are given to these various protozoans, there seems to be no injury. Thus Stylonychia (including dividing forms), irradiated even with as large a dosage as 219,000 ergs/mm^2 at the midpoint of the exposure cell, showed no signs of destructive effects even after 48 hours; in fact a vigorous culture developed following irradiation. Paramecia irradiated with as high a dosage as 191,000 to 200,000 ergs/mm^2 divided actively following their addition to bacterized medium; and when placed under conditions favorable for conjugation[7] they conjugated comparably to controls 72 hours after irradiation. The ability to divide and conjugate entirely normally would indicate that the Paramecia were but slightly affected. Paramecia irradiated with a dosage of 206,000 ergs/mm^2 at 3,660A (intensity: 100 ergs/mm^2/sec.) seemed entirely unaffected.

At 3,025A, about 20 per cent. of the light incident upon a Paramecium is absorbed, whereas at 3,130A only about 3 per cent. is absorbed.[6] One would expect a proportionally weaker action of the longer wavelength for a given incident radiation on the basis of the absorbed energy. But even when the incident dosage at 3,130A is increased 12-fold (200,000 ergs/mm^2) over that necessary to kill at 3,025 (16,500 ergs/mm^2) the Paramecia were apparently unaffected. The energy absorbed must be voided without obvious injury.

[5] Giese and Taylor, *Arch. Prot.* In press.
[6] Giese and Leighton, *Jour. Gen. Physiol.* In press.
[7] Giese, *Physiol. Zool.* In press.

Possibly at higher intensities lethal effects might be manifested at 3,130A. Such experiments are planned with the use of another light source. However, the intensities reported by Weinstein are low compared to those employed in the present work. It therefore seems probable that the strong lethal effects reported by him were due to impure light at 3,130A, since the large fused quartz prism in his monochromator may have scattered the lethal shorter wave-lengths to a considerable degree.

That there should be so sharp a difference in lethal action between regions of the spectrum so close together as 3,025 and 3,130A is not surprising in view of the partition of these wave-lengths in the sunlight at the earth's surface. According to Fabry and Buisson[8] the energy at 3,022A on June 7, 1920, with the sun at the zenith, was 2,700, whereas the energy at 3,143 was 22,400 (arbitrary units). Therefore, even at this time of the day, when the intensity of light of the shorter wave-lengths is greatest, the energy content at 3,022 is less than one eighth that at 1,143A. Earlier and later in the day the fraction is much smaller. One would therefore expect organisms to be so adapted to that part of the sun's spectrum in which light is present in relatively high intensities as to absorb little and to be able to get rid of the small amount absorbed without injury. The wave-length 3,130A is beyond the limit of the strong absorption band of the protoplasm of bacteria,[9] Paramecium,[6] and human skin[10] as well as of proteins[11] and of nucleoprotein derivatives.[12] And one finds little action at 3,130A; this is true not only for lethal action, but also for erythema production.[13] The small amount of energy which is absorbed under experimental conditions is apparently voided without noticeable injury.

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[8] Fabry and Buisson, "L'Absorption des Radiations dans la Haute Atmosphere," 1930.
[9] Gates, *Jour. Gen. Physiol.*, 14: 31, 1930.
[10] Bachem and Kunz, *Arch. Phys. Therapy, X-ray, Radium*, 10: 50, 1929.
[11] Henri, Henri and Wurmser, *Compt. Rend. Soc. Biol.*, 73: 319, 1912.
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SCIENCE

VOL. 81 FRIDAY, JANUARY 18, 1935 No. 2090

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE SOCIAL SCIENCES AND NATIONAL PLANNING[1]

By Professor WESLEY C. MITCHELL

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AN impression prevails in many minds that social science has made out a case against national planning, at least in economic matters. This impression is the vestigial remnant of what used to be a vigorous belief. English political economy arose as a destructive critique of the national planning done by mercantilist statesmen and as a constructive argument for a policy of *laissez-faire*. But since Adam Smith published "The Wealth of Nations" in 1776, economic practise and economic theory have been evolving rapidly, each acting continuously upon the other. Present opinions upon national planning are the outcome up to date of these historical developments in the field of practise and of theory, which I shall sketch as briefly as I can.

I

The aim of mercantilist planning was to mobilize economic forces for national aggrandizement. The country should have a numerous population; the common people should be trained in husbandry and the crafts, inured to labor and kept from the consumption of luxuries that are merely pleasant, such as sugar and tea. The necessaries of life should be produced at home as a precaution against foreign attack; the mercantile marine should be fostered as an auxiliary of the navy; an abundant supply of the precious metals is desirable both for home trade and as the sinews of war. To guarantee this supply countries that have no mines of gold and silver must see that the balance of trade is "favorable." To that end, exports should be encouraged, and imports discouraged, except in the case of commodities destined for resale abroad or of raw materials for domestic manu-

[1] Address as retiring chairman and retiring vice-president of the Section for Social and Economic Sciences, American Association for the Advancement of Science, Pittsburgh, January 1, 1935.

factures. Private enterprise should be directed toward industries that the government is trying to develop on national grounds; colonies should get most of their manufactured goods from the home country and send raw materials in return; foreign commerce should be supervised to make sure that merchants comply with the national plan.

Of course this scheme of statecraft involves national economic planning of an elaborate, continuous sort, calling for eternal vigilance on the part of statesmen and tending to develop into detailed regimentation of economic life. The occupation a youth may choose, the apprenticeship he must undergo, the wages he may receive, the places in which he may live and work, the commodities he may consume, the products which his master may make, the technical processes to be followed, the standards of materials and workmanship to be observed—these are but samples of the matters which mercantilism sought to control in its heyday.

This type of national planning grew up as centralized states emerged from the confusion of feudalism, and prevailed with numberless variations of detail over Central and Western Europe for two or three centuries.[2] At many points, the mercantilist regulations stood in the way of enterprising money makers, or even created opportunities to make money by breaking the law—for example, by smuggling. Hence the system tended to break down in detail whenever the administration of the laws grew lax for any reason. Certainly in England and her colonies, private disregard of mercantilist regulations became a mass phenomenon in the eighteenth century. Nor did the authorities try hard to stop all infractions of the law. One may say that *laissez-faire* was practised on a considerable scale before it was preached as a formal doctrine.

Adam Smith was not the first, but he was the most effective critic of mercantilist planning. His argument can be summed up in a syllogism: first, every individual desires to increase his own wealth; second, every individual in his local situation can judge better than a distant statesman what use of his labor and capital is most profitable; third, the wealth of the nation is the aggregate of the wealth of its citizens; therefore, the wealth of the nation will increase most rapidly if every individual is left free to conduct his own affairs as he sees fit. There need be no fear that consumers will be exploited under such a system; competition among producers is a sufficient safeguard against that danger. To make gains for himself each producer must offer goods which others want at prices set by competition. Thus, in pursuing his own gain, every producer is led to promote the public interest.

[2] Any brief sketch of mercantilist policies must be schematic to a degree. The present sketch is probably least misleading as a representation of the policies which Colbert sought to carry out in France.

By formulating this argument with the authority of a moral philosopher, Adam Smith offered his contemporaries a justification of acts which thousands had been performing with a bad conscience. The "rationalization" lent new vigor to private disregard of hampering regulations and so contributed toward the breakdown of mercantilism. It is hard to-day to realize how Adam Smith clarified the minds of men and lifted their hearts with his ringing call to adopt "the simple and obvious system of natural liberty." His was a great service to blundering humanity during the difficult transition that lay so near at hand. And that service was accepted with a promptness which has few parallels in the history of thought. Far more rapidly than he had supposed possible, Adam Smith's views were adopted by other thinkers, by business men and by statesmen. Supplemented by the philosophical radicalism of Jeremy Bentham and his disciples, restated to fit changing conditions by later economists, *laissez-faire* became the dominant maxim of British economic policy and exercised a powerful influence upon thought and action throughout the western world. We may almost say that for two generations the British government planned to to have no plan.

II

Economists no longer celebrate "the simple and obvious system of natural liberty" after the sweeping fashion of Adam Smith. Social organization has become vastly more complex than it was in the eighteenth century; business planning and government planning have become closely intertwined with one another; discussions of their rôles in guiding economic activities now deal with the diversity of conditions produced by a century and a half of the industrial revolution.

Even while they were in process of assimilating the doctrine of *laissez-faire*, the English people began using their government as an agency for correcting what they thought to be bad results of private enterprise. Some of these governmental controls could be defended by a shrewd interpretation of Adam Smith's logic. Thus laws to protect child workers and presently laws to limit the hours worked by "young persons" and women could be defended on the ground that minors and women of any age were not in fact the best judges of what is good for them. Public opinion came to believe that it was foolish to permit even grown men to take the risks of overloaded ships, unfenced machines, ill-ventilated mines, or occupational diseases, however accustomed they might be to do so, and successive parliaments passed laws to re-

duce industrial hazards of many sorts. If the mass of the wage-earners were as blind to their economic interests as the Malthusian principle of population represented them to be there was reason for tutelage in many matters. Compulsory education came to seem an obvious need. The industrial revolution called for operatives who could read blueprints and clerks who knew arithmetic. Democracy, the political complement of economic liberty, demanded literate citizens. Accordingly, the government went much further than Adam Smith recommended in providing education at public expense and forcing parents to accept it for their children. Adam Smith had justified state provision of public works; the list of such works grew with the density of population and scientific knowledge of public hygiene. The rise of the gas industry, of railroads, of tramways, of the telegraph, the telephone, electric lighting and power transmission built up a great class of public utilities midway between the fields of private enterprise and public works. These utilities could not serve the public cheaply and efficiently under such competitive conditions as worked well in manufactures and trade; they were "natural monopolies," and as such they could be subjected to special regulation, or even owned and operated by governments that professed the doctrine of *laissez-faire*. Presently, it began to appear, though more strikingly in the United States than in Great Britain, that in many industries competition was breeding combinations. The joint-stock company, which Adam Smith had thought of as limited by its own competitive inefficiency to a brief list of trades requiring vast capital rather than active enterprise, proved admirably adapted to the factory age with its heavy investments, once the principle of limited liability had been accepted. Incorporation made it easy to organize business enterprise in units large enough to dominate whole industries. Once more, government intervention could be justified on familiar grounds. Adam Smith had taken it for granted that the consumer, for whom he felt tender solicitude, would be protected against exploitation by competition among numerous producers. If that was ceasing to be the case, it seemed logical that government should break up the monopolistic corporations and force the fragments to compete again.

So far I have mentioned governmental actions intended to remedy what were thought to be bad results of business planning or to supply social needs for which business planning made no adequate provision. I go on to list various shortcomings of business planning that are troubling our minds to-day, shortcomings which government is often called upon to correct or to supply.

A specter that has troubled men's minds more and more as the industrial revolution makes headway is the rapid depletion of natural resources. In 1865 W. Stanley Jevons pointed out that the fixed limits of coal deposits made it impossible that Great Britain should long maintain its current rate of increase in industrial output. Somewhat later Americans began to feel apprehensive about their supplies of lumber, natural gas, oil and other minerals. Now we are becoming dimly fearful about the loss of soil fertility through reckless methods of cultivation and erosion. The appalling wastes of natural resources that are going on seem due largely to the policy of handing over the nation's heritage to individuals to be exploited as they see fit. It appears that business planning takes and must take a relatively short period of time into account—a period that is but as a day in the life of a nation. What is rational on the basis of this short-run private view may be exceedingly unwise on the basis of long-run public interest. We see now how vital a factor Adam Smith overlooked in taking the nation's wealth as the aggregate of the wealth of its individual citizens. And what can be said about the wasteful use of natural resources by private enterprise can be repeated with increased emphasis regarding the use of human resources. Private enterprise draws thousands of youths into "blind-alley" occupations from which they emerge little fitted to assume the responsibilities of mature life. The work it provides for millions of adults fails to make use of their full capacities and leaves many the victims of "balked dispositions." We have allowed our immediate economic interests to lead us into modes of living which fail to satisfy our emotional needs and our creative impulses.

Experience is showing also that, great as are its contributions to social welfare, business planning has a formidable array of technical limitations of which we are becoming increasingly conscious as the years pass and as our ideas of what is possible to mankind grow more daring.[5]

Business planning can secure effective coordination of effort only within the limits of each independent business enterprise; that is, each group of business activities subject to a single financial control. It can not effectively coordinate the activities of independent enterprises.

Coordination within an enterprise is the result of careful planning by experts; coordination among independent enterprises cannot be said to be planned at all—rather it is the unplanned result of natural selection in a struggle for business survival. Coordination within an enterprise has a definite aim—the making of profits; coordi-

[5] In the following five paragraphs, I venture to reproduce with minor changes passages which I contributed to the "Report of the National Resources Board," pp. 81, 82. Washington, Government Printing Office, December, 1934.

nation among independent enterprises is limited by the conflicting aims of the several units. Coordination within an enterprise is maintained by a single authority possessed of power to carry its plans into effect; coordination among independent enterprises depends on many different authorities which have no power to enforce a common program, except so far as one can persuade or coerce others. As a result of these conditions, coordination within an enterprise is characterized by economy of effort, coordination among independent enterprises by waste.[4]

The planning of business enterprises aims at making money. If the ultimate test of economic efficiency is that of satisfying the most important social needs in the most economical manner, then business planning must be warped by inequality in the distribution of income. Where a few have money enough to gratify almost any whim and where many can not buy things required to maintain their efficiency or to give proper training to their children, it can hardly be argued that the goods which pay best are the goods most needed.

From the view-point of business itself, planning to make money is a precarious undertaking that often ends in heavy losses or financial ruin. However skilfully the internal affairs of a corporation are managed, the whole venture may be wrecked by circumstances beyond the control and even beyond the knowledge of the managers. As markets grow wider, investments heavier and financial interrelationships more complicated, it becomes harder for the ablest management to anticipate the conditions which the next few years will bring forth. The movement toward business combinations is largely a business man's remedy for uncertainty—his effort to extend the number of factors which he can control. But combination by one group of enterprises increases the hazards for other enterprises. It is not surprising that with growing frequency business men have turned to the government for aid and demanded that it protect them against hazards which they can not control, including the hazard of combinations among other business men.

The frequent recurrence of economic crises and depressions is evidence that the automatic functioning of our business system is defective. In view of recent events no one longer holds that the business cycle is being "ironed out." Instead, it appears that the difficulty of maintaining the necessary equilibrium among different factors in the enormously complicated mechanism is becoming greater rather than less. Aside from the widening of markets and the growth of combinations mentioned above, we face the fact that an increasing part of the annual output consists of semi-durable goods which people can stop buying for a time if times are bad. The drift of population from farms to cities and the diminishing dependence of farm families upon what they can make for their own consumption, their increasing dependence upon selling farm produce to get the wherewithal for buying other goods, mean that general economic maladies afflict more people more seriously than they did in past generations. Business planning has found no effective means of preventing the growth of these factors that tend to make the business-cycle hazard more serious.

When a grave depression occurs, recovery is retarded by the divergence between the policies followed by powerful corporations in highly organized industries and the policies that are forced upon small producers in simply organized industries, of which farming is much the most important. Formerly, when a depression came, prices fell in almost all markets. This decline proceeded until the resulting checks upon production and stimulations of purchasing produced a new equilibrium between the demand and supply of most commodities at prices lower than those prevailing during the preceding phase of expansion. Then business activity began to pick up again. The revival came about automatically: business men had merely to look after their individual interests, and government to remain a passive spectator, or at most to increase its allowances for the support of the poor. Of late, this automatic process of recovery has become less prompt and effective. The managers of great corporations usually believe that the best way to minimize their losses during a depression is to maintain prices, despite the heavy falling off in sales and production which is likely to follow. That policy will at least cut down the heaviest items of current expense —cost of materials and wages. But farmers, who individually can exercise no control over the prices of their products, must continue to produce as much as they can and to sell for what they can get in a community where many consumers have lost their jobs. Because their incomes are cut by low prices, the farmers can not buy freely from the corporations that are keeping their prices relatively high. Because farmers, other small producers in a similar position and their former employees who are now out of work can not buy freely, the rigid-price corporations have small inducement to increase output and put men back to work. Recovery under such conditions is a far slower and more halting process than it was when all prices were flexible in much the same degree.

If business men are justified in demanding that government take measures to protect them against the hazards of trade, how much stronger justification for

[4] See Wesley C. Mitchell, "Business Cycles: The Problem and Its Setting," p. 172. National Bureau of Economic Research, New York, 1927.

such a demand have wage-earners! The day when it was plausible to argue that steady work comes to steady workmen is past. Sobriety, industry, thrift will not enable a man to keep his job if the company which employs him shuts down. Nor is it his fault if he can not get a new job promptly when there are ten applicants for every opening. Cyclical unemployment is the labor side of the business-cycle hazard, and, as said above, that hazard is not shrinking. Technological unemployment is the labor side of industrial progress and that hazard is growing. Economic security for wage-earners, much the most numerous class of people in a commercial nation, certainly has not been provided by business planning.

Finally, we are often told nowadays that, even in the best of business years, our present economic organization prevents us from making full use of the technological skill we have attained and of the capital we have accumulated. As a rule, statements of this sort are vague and sweeping, better calculated to arouse interest than to convince a skeptic. But recently two efforts have been made to get more definite ideas about the margin by which actual production at the peak of prosperity falls short of what production might be if we could make full use of our facilities. In 1933, twenty-eight engineers of experience in various industries were persuaded to submit estimates of how much the aggregate output of all industries might be increased simultaneously with existing equipment and methods, provided a ready market could be assured for the products. More than half of the estimates ran above 25 per cent. Asked what increase might be expected if the equipment and management of all industries were "brought to the level of the best current practise" half of the engineers gave estimates of 60 per cent. or more. Second, an elaborate statistical study of the proportion of the country's capacity for production that was utilized in 1925–29 has yielded similar results. The conclusion drawn was that, taking the full gamut of operations from agriculture and mining, through manufactures and transportation to retail distribution, it would have been feasible to produce nearly 20 per cent. more goods than we did by the methods then in use and with the equipment and labor we then possessed.[3] Thus the charge that our economic organization fails by a wide margin to secure the full use of our productive capacity even in years of business activity is sustained by both of these inquiries. An increase of a fifth or a quarter in the national income above the highest levels yet attained seems to be technologically feasible merely through fuller use of the equipment and methods in use. If the engineers are right, these increases might be doubled or trebled by bringing equipment and management in all enterprises abreast of the best current practise.

To draw up a list of errors and omissions under business planning is not to damn private enterprise. Few dispositions seem to me more misguided than the disposition to regard business as a monster which prevents suffering humanity from attaining its heart's desire. After all detractions are made, the historical fact remains that, in the countries which have given wide scope to private initiative since Adam Smith presented his momentous argument for *laissez-faire*, the masses of mankind attained a higher degree of material comfort and a larger measure of liberty than at any earlier time of which we have knowledge, or under any other form of organization which mankind has tried out in practise. These blessings of relative abundance and freedom arise from the rapid application of scientific discoveries to the humdrum work of the world, and that application has been effected mainly by men who were seeking profits. In societies organized on the basis of making money, *laissez-faire* put the stupendous drive of private gain behind the industrial revolution. Further, the capital required for building machines, factories, railroads, steamships, electrical equipment and the like was accumulated mainly from profits made by business men and investors and used, not to satisfy their own wants, but to provide new equipment for production. As Adam Smith argued, in pursuing their private gain business men were led to promote the public welfare.

III

Yet no class in the community has been satisfied with the workings of private initiative. From capitalists to farmers and working men, all of us have tried to use government as an agency for bettering economic organization. The way in which government should be used has been the central issue of our political struggles more often than the question whether government should be used at all. For few of us have been willing to trust what Adam Smith regarded as "natural" forces. Instead, we have cherished ambitious designs of harnessing social forces much as we have harnessed steam and electricity.

Nor have these attempts been fruitless. The familiar contrast between the rapid industrial progress since James Watt invented the separate condenser and the slow social progress since Watt's friend Adam Smith published the "Wealth of Nations" is often exaggerated. England in 1934 is a very different society

[3] See "Economic Reconstruction," Report of the Columbia University Commission, pp. 87–104, New York, 1934; Edwin G. Nourse and Associates, "America's Capacity to Produce," pp. 415–425, Washington, 1934.

from the England of 1776, and the difference is not limited to technology. For example, the working-class babies of this year will have educational opportunities which were closed to their ancestors; their choice of occupations will be wider; they will work fewer hours; their livings will be more secure; they will dwell in less hideous and more healthful towns; fewer of them will be maimed at work or contract occupational diseases; their span of life will be longer; they will be free to unite with their fellows in promoting their common interests; they will have a share in governing their country. These advantages they will owe to the long series of social reforms which have been enacted one after another, and which these babies of 1934 will have a better chance to extend in their turn than had the working-class babies of 1776.

But considerable as the advances effected in social organization during the last century and a half have been, the pace has been less rapid in this field of effort than in the field of industry. To explain this cultural lag is not difficult.

First, the social sciences which are needed to guide efforts to control social forces are less precise and dependable than the natural sciences which guide efforts to control natural forces. That difference in the character of man's knowledge in these two fields is due to the vastly greater complexity of social phenomena, and to the conditions surrounding research in the two fields. In the one field experiments can be tried within the limits set by expense; in the other field experimentation is not wholly barred, but it is narrowly restricted.

Second, applications of social science to practical affairs rarely promise a personal profit to the innovator. At most he may dream of being honored by his fellow men.[6] Still more rarely can a second advance be financed from the proceeds of past successes. Thus the drive of profit, which gave such energy to the industrial revolution, has not pushed forward the social revolution. The Communist Manifesto told the workers of the world in 1848 that they had "a world to gain" by uniting; but this vague incentive to millions was a less effective spur to action than the concrete prospect of profits to individuals. And now that the workers of one country have captured the government and begun an experiment in communism, the workers of other countries seem inclined to wait for the gains to materialize before imitating the Russian example. Also the process of initiating industrial improvements is far simpler than the process of initiating social improvements. Any innovator who could command a modest capital might adopt what he believed to be an industrial improvement without more ado. If his faith proved justified, he could coerce his competitors to follow his example under penalty of commercial ruin. The innovator who wants to secure what he believes to be a social improvement must convince many men before he can secure a trial of his plan, and for convincing men he must rely upon persuasion. More commonly than not, the projected change threatens some vested interest, and the would-be reformer's campaign of education has to meet a well-financed counter campaign. The social innovator can not coerce anybody until he has won government; the industrial innovator brings coercion to bear upon his competitors as soon as he begins to undersell them. Finally, experiment plays a rôle in the applications of science not less important than its rôle in scientific discovery. Again the advantage is all on the side of the natural as opposed to the social sciences, of industry as opposed to social organization. Social like mechanical inventions are usually crude at first; both types need to be perfected in detail before they will work well. In industry this process of improving upon the original design is facilitated by practical trials on a small scale before large risks are taken. In social organization similar experimental runs are sometimes feasible; but often that is not the case. Nations must try many innovations upon a large scale or not at all; the crudities of the first plan must be discovered at heavy cost and eliminated by a process almost as halting as the process of inducing government to make the first venture.

IV

Beset by so many difficulties, social planning has run a most uncertain course during the last century and a half, while the industrial revolution has been marching forward. In England and the United States most of the attempts to use governmental agencies in new ways have been piecemeal efforts started by private citizens to remedy some single bad situation. Philanthropists have played the leading rôles in many of these efforts; in others, groups that felt themselves aggrieved or oppressed have provided the spokesmen. To get what they wanted, these leaders have had to use the arts of propaganda and organization directed to the one specific aim in view. England has produced two great groups of thinkers who developed systematic programs of social reorganization—the Philosophical Radicals in the opening decades of the 19th century and the Fabian Socialists in the closing decades; but in so far as their plans have been carried out, it has been on the empirical

[6] Of course this remark does not apply to all efforts to secure governmental action. The advocates of a tariff bill, for example, may expect and achieve substantial profits. But legislation promoted for private gain is seldom an application of social science to practical affairs.

basis of one thing at a time and mainly through men who did not count themselves members of the groups in question. In this country it is hard to find even one group of systematic planners to set beside the Benthamites and the Fabians.

A less numerous but more imposing class of national plans are those that have been drawn by governments to meet grave emergencies. The most striking examples are the economic mobilizations effected during the world war and the efforts of President Roosevelt's administration to cope with the great depression. Other governments have been bolder in trying to change the social organizations of their peoples. Perhaps the most demonstrably successful case of systematic government planning which the world offers is that of Japan. When the Shogunate was abolished and the Mikado was restored to power in 1867, the responsible statesmen of the country deliberately undertook to transform their feudal realm into a modern commercial state with the standard accompaniment of military power. How rapidly they have progressed toward this end within the short space of two generations every one knows. Bismarck's plans for German development are the most notable European achievements of pre-war days in constructive government planning. Of course we can now add to the list the grandiose experiments of communism in Russia and of fascism in Italy.

Both types of planning that have prevailed in this country—efforts to solve one problem at a time and efforts to meet national emergencies by quick action —have grave defects. The piecemeal method overlooks the interdependence which is so important a characteristic of social processes. Change one feature of social organization and you are certain to change many other features also. Some of the changes you did not plan you will not like. For illustrations, recall the results that flowed from the thirteenth amendment to the constitution abolishing slavery and from the eighteenth amendment that sought to abolish the liquor traffic. It is only by very careful study of the social situation as a whole that changes can be made with a maximum of beneficial and a minimum of harmful effects. As for emergency planning in the face of impending disaster, it is certain to be defective in many ways just because there is not time enough to use what wisdom we have.

Critics of both the piecemeal efforts of reformers and of the inspirational efforts of statesmen acting in a hurry can make out a strong case against much if not most of the national planning we have done in this country. But any one who attempts to check the practise of national planning will argue in vain. So long as men have power to think, private citizens will go on devising plans for what they find amiss in social organization, and some of their plans will win general approval. Also, so long as we continue to encounter national emergencies from time to time, our government will go on adopting hurried measures. The course of wisdom is not to oppose national planning, but to make that planning more intelligent. The more clearly any man grasps the enormous difficulties of the task, the more sharply he realizes the harm done by poor planning, the keener he should be to promote intelligent plannning: for national planning of some sort, or rather of many sorts, we are certain to have.

The two great improvements needed in American planning are recognition of the interrelationships among social processes and preparedness to deal seriously with social problems before they have produced national emergencies. It is possible of course that our future reformers will have a wider field of vision than their single-eyed predecessors. It is possible, also, that our government in future will be more alert to coming troubles even when times are good. Let us hope so. But may we not also set ourselves to organize our intelligence for a systematic consideration of social problems and how they may best be solved?

An organization devoted to these aims we have never had; for no President and cabinet can take time from their pressing executive duties for systematic long-range planning. Such planning is a task that demands the full time and energy of the ablest men in the country. And the abler these men, the more eager they would be to secure the services of a varied technical staff and the counsel of a wide circle of advisers. Indeed, a competent National Planning Board would conceive itself, not as depending upon its own wisdom, but as an agency for focussing the intelligence of the nation upon certain issues, in the hope of formulating plans that would command sufficient confidence among their fellow citizens to be given trials. It is only as an advisory body that such a board would fit into the American scheme of institutions. A large part of its task would be to draw the line between cases in which government should seek to exercise control and cases in which private initiative should prevail. To preserve the effective liberty of the individual in the modern world requires national planning of as shrewd and elaborate a sort as the planning required to check abuses or to supply lacks. Indeed, it is only by preventing one group of citizens from exploiting other sets and by supplying those services which private enterprise can not render that individual liberty can be secured.

How much a National Planning Board with advisory powers might improve upon our efforts to solve social problems by taking thought no one can tell in advance. What I have said about the difficulties which beset the social sciences warns us that suc-

cess is not a foregone conclusion. To supply deficiencies in knowledge the board would doubtless have to undertake much research through its own staff or through other agencies. But after doing its best to lay a scientific foundation for its plans, the board would often have to advise proceeding in an experimental fashion on the basis of probabilities. It would be doing pioneer work; for it would be trying to better the social organization of one of the most advanced countries in the world—to do things which have not yet been done. Hence it could not expect to achieve as brilliant a record as did the elder statesmen of Japan, who were seeking to pull abreast of other nations and so had models to imitate. And of course the usefulness of the board could be wrecked by the appointment of men chosen for partisan reasons. Or a board of men possessing technical competence but lacking in other qualities might antagonize the Executive, Congress and the public, and so lose its influence. Perhaps the idea of trying to mobilize the intelligence of the country for systematic and continuous study of social problems will be rejected by public opinion. But it would seem that we have had enough experience with reforms that produce almost as much harm as they remove to be willing to try a more scientific method of dealing with social problems.

SCIENTIFIC EVENTS

THE AGRICULTURAL PROBLEMS OF MEXICO

THE special correspondent of *The Christian Science Monitor* writes from Mexico City that the 35,829,500 acres of arable land can not be cultivated until the population has reached at least 30,000,000 inhabitants. This statement, made in a recent study by A. Lozcano, agricultural engineer, and regarded as an argument that Mexico should let down its immigration bars, followed closely upon the recent publication of a symposium by a group of Mexican technicians, of which Señor Lozcano was one.

The symposium, entitled "The Agricultural Problem of Mexico," according to the correspondent, was issued at a time when other effects of Mexico's preoccupation over problems of population and their relation to more organized and efficient production were beginning to show themselves.

One instance was the announcement of plans for the founding of ten new cities on different irrigation systems, and another the continued pace at which commonland-grants are being parceled by the government, a total number of 7,141 peasants having been provided with such parcels during the month of September.

The problem of improving means and methods of better cultivation are said to have been greatly exaggerated in Mexico. That phase of the question is secondary compared with that of increasing the agricultural and national population.

The ten cities to be constructed by the National Irrigation Commission on as many national irrigation systems in different parts of the country will represent a total outlay of about 5,000,000 pesos, or an average of 500,000 pesos each.

The new centers will be modeled after the agricultural city, Anahuac, built last year on National Irrigation System No. 4 in the northern part of the country, and which now has a total population of about 5,000. They will include complete water, drainage and light systems, well laid out streets, office buildings, shops, warehouses, post office and telegraph service, branches of agricultural banks for colonists and common land-grant owners and hotels.

The purpose of the new cities is to provide a more comfortable way of living for the thousands of colonists and to give them the benefit of more modern social and educational advantages.

When work now being carried on at different systems is concluded, 728,945 acres of land will be under cultivation. Every system has its chain of highways and roads connecting it with important distribution centers. According to the report, the efficiency with which this work has been carried on and the systems put to practical use are superior to those shown by similar services in other countries.

Plots are obtained by immediate payment in full, or by promise-of-sale contracts of two types, short and long-term—the latter covering a period of from 24 to 25 years.

THE LINDBERGH COLLECTION OF SPORES IN ARCTIC AREAS

COLLECTIONS of micro-organisms which Colonel Charles A. Lindbergh made on his flight through the Arctic areas in the summer of 1933 are described in the January issue of *The Scientific Monthly*, by Fred C. Meier, senior agriculturist, U. S. Department of Agriculture, with field notes and material by Colonel Lindbergh. Mr. Meier has been studying air-borne organisms for several years—particularly those that drive northward over the plains each year to spread rust in the wheat fields. He interested Colonel Lindbergh in making this contribution to the scientific work of the department, and together they worked out new and improved apparatus for taking samples of the micro-flora of the Arctic air.

Colonel Lindbergh devised a spore trap which he

called "the skyhook," a light, strong contrivance, easy to operate, and well adapted to protecting the sterile glass slides from contamination except for the time they were exposed. Mr. Meier prepared the slides and has examined and photographed them. He credits Colonel Lindbergh with careful and painstaking work and says that "Colonel Lindbergh's knowledge of pure-culture technic made him thoroughly aware of the necessity of developing a trap that could be used with minimum danger of error resulting from contact with dust in the cockpit."

In his flights between the American mainland and Denmark, by way of Greenland and Iceland, Colonel Lindbergh exposed 26 slides and returned them with field notes and free-hand maps indicating exactly where and for how long, and under what conditions each slide had been exposed. Mr. Meier has taken care of the preservation of the slides and has examined and photographed representative sections. He has been able to identify the genus and in some cases the species of many of the objects trapped in the petroleum jelly which covered the slides. More complete identifications will in many cases have to await the assistance of botanists familiar with the characteristics which identify various kinds of pollen, and of scientific workers who are specialists in different groups of fungi, mosses and lichens. On one slide, exposed far north of the Arctic Circle, Mr. Meier was able to discover under the microscope more than 40 different types of objects in a space five centimeters square. This was on a slide exposed 3,000 feet above sea level along the northeastern coast of Greenland.

Mr. Meier and other Department of Agriculture workers, assisted by Army, Navy and Coast Guard flyers, have done a considerable amount of aerial work in trapping spores and other micro-organisms, but this has been overland and in places where it was to be expected that the catch would be abundant. "This Lindbergh collection," according to Mr. Meier, "is the first of its kind to give concrete evidence of the part played by air currents in the distribution of fungi between northern lands." He points out the possibility that a single living spore which is transferred by the air currents and dropped in a spot favorable for reproduction might create a center for rapid spread of infection.

GRANTS IN AID OF RESEARCH ADMINISTERED BY THE NATIONAL RESEARCH COUNCIL

THE National Research Council has been informed that the Rockefeller Foundation has appropriated $80,000 to the council to be used for individual grants in aid of research in the natural, medical and mathematical sciences during the ensuing three-year period, 1935–37. This fund is available for use in grants of moderate size (usually less than $1,000) for the purchase of apparatus, materials and supplies, for employing technical assistance, and for field expenses. In general grants will not be made for personal services or fellowship stipends, for expenses of publication, for the purchase of books, for travel to attend scientific meetings, or for the research work of students under instruction. In the awarding of grants preference is ordinarily given to the support of investigations (a) in which the problem itself and the methods to be employed are clearly stated and in which definite results can be expected with the aid of a single grant and (b) toward the prosecution of which the university or other institution also contributes financially or through other special support. The fund is administered by a special committee of the Research Council composed of the chairman and the treasurer of the council, together with the chairmen of the council's seven divisions of science and technology.

Applications for grants to be made this spring should be submitted before April 1, 1935. Correspondence should be addressed to Dr. C. J. West, secretary, Committee on Grants-in-Aid, National Research Council, 2101 Constitution Avenue, Washington, D. C.

During the past five years the Rockefeller Foundation has appropriated to the National Research Council sums for individual grants and for conferences totaling $370,000. From these sums 638 grants have been made for the support of individual investigations and for conferences for the construction of research programs or for the coordination of research on special subjects.

ISAIAH BOWMAN,
Chairman

ANNUAL MEETING OF THE METALLURGICAL ADVISORY BOARD

REPORTS on metallurgical investigations made at the Carnegie Institute of Technology during the past year will be given by a group of investigators at the eighth annual open meeting of the Metallurgical Advisory Board to be held at the institute on Friday, February 8. Approximately 400 metallurgists are expected to attend the meeting.

Dr. John Johnston, director of the department of research and technology of the U. S. Steel Corporation, will preside at the morning session, and Dr. Frank N. Speller, chairman of the Advisory Board, will give the address of welcome.

Progress made by the Metals Research Laboratory in theoretical investigations will be reported by the director, Dr. R. F. Mehl. The various projects now being studied in the laboratory are classified under four major heads, namely, plastic deformation of metals, precipitation from solid solution, oxidation of

metals and diffusion in metallic alloys. Dr. F. M. Walters, Jr., formerly of the staff, will offer a final report on the alloys of iron, manganese and carbon, which he investigated for a period of several years at the institute.

Dr. Cyril Wells, also of the metals laboratory, will explain the preparation and properties of high purity iron and will report on a study of the constitution and properties of a pure sample. The final report of the morning session will be read by B. N. Daniloff, research fellow, on "The Effect of Deoxidation on the Aging of Mild Steels."

At the afternoon session at which H. W. Graham, general metallurgist of the Jones and Laughlin Steel Corporation, will preside, Dr. Charles H. Herty, Jr., formerly director of research for the Metallurgical Advisory Board, will report on the studies which were made under his direction.

These reports will conclude the program of research on the physical chemistry of steel-making which has been carried out for the past eight years by the Metallurgical Advisory Board. A group of prominent metallurgists from the industry will discuss the findings.

An informal dinner at the University Club will conclude the meeting. The speaker on this occasion will be J. Steele Gow, director of the Falk Foundation, who will speak on "Research in the Economic Field." The laboratories of the Carnegie Institute of Technology will be open for inspection for visitors on Saturday morning.

THE DIRECTORSHIP OF THE AMERICAN MUSEUM OF NATURAL HISTORY

At a meeting of the Board of Trustees of the American Museum of Natural History on January 7, Dr. George H. Sherwood resigned as director to give his entire time to the School Service Section as curator-in-chief of education. Dr. Sherwood will remain honorary director of the museum. Dr. Roy Chapman Andrews, explorer and naturalist, will succeed Dr. Sherwood as the active head of the museum.

In reference to these appointments a correspondent writes:

Dr. Sherwood has been connected with the American Museum since 1902 when he became assistant curator of invertebrate zoology. From 1906 to 1911 he was assistant secretary of the museum; from 1911 to 1921, executive secretary; from 1924 to 1926, acting director. He became director in 1927.

During the years of his directorship, the museum has undergone rapid expansion. Akeley African Hall and the Whitney Hall of Oceanic Birds are well on their way to completion. A new Reptile Hall, with all the most recent methods of mounting and groupings, was opened in 1929 and the Hall of South Asiatic Mammals. Collections for the African Hall have gone steadily forward. Of the twenty-eight groups planned, half are finished or nearing completion. Last fall work was started on the new Hayden Planetarium, which will be ready in the spring. The Department of Education was conducted wholly within the museum up to 1904 when the first outside contacts were made through the distribution of nature-study collections to the schools. Since then, the school work has rapidly expanded. Last year, more than 30,000,000 contacts were made with New York school children through lectures, films, lantern slides and circulating collections. During the past few years, Dr. Sherwood has pushed the educational work further and established classes for teachers in museum instruction through cooperation with the College of the City of New York and New York University.

As leader of the Central Asiatic Expeditions of the American Museum of Natural History, Dr. Andrews took his first expedition into the field in 1916 to work in the territory of Thibet, Southwest China and Burma. His second expedition went into North China and Outer Mongolia in 1919, and the third expedition has worked in Central Asia, especially in Mongolia, since 1921, where it uncovered some of the richest fossil fields in the world. This was the largest and most completely equipped land expedition ever to be sent out up to that time.

In 1918, Dr. Andrews served in the Intelligence Service in China. He was awarded the Elisha Kent Kane Gold Medal of the Philadelphia Geographical Society previously given to only eight explorers. Brown University and Beloit College have both conferred on him the degree of honorary doctor of science. He has been given the Hubbard Medal of the National Geographic Society in recognition of his discoveries in Asia.

Dr. Andrews is well known as a lecturer and author of popular books and articles on the results of his various expeditions, including "On the Trail of Ancient Man," "Ends of the Earth," "Whale Hunting with Gun and Camera," "Camps and Trails in China," "Across Mongolian Plains," and a large volume covering his entire field work in Mongolia and China up to the present time, entitled "The New Conquest of Central Asia."

RECENT DEATHS

Dr. Oliver Peebles Jenkins, emeritus professor of physiology and histology at Stanford University, died on January 9. He was eighty-four years old.

Professor George Leonard Hosmer, a member of the department of civil engineering at the Massachusetts Institute of Technology for thirty-seven years until his retirement last October, died on January 10. He was sixty years old.

Dr. Wilbur Garland Foye, professor of geology at Wesleyan University, died on January 8, at the age of forty-nine years.

Dr. Alfred Owre, until his resignation in 1933 dean of the School of Dental and Oral Surgery at

Columbia University and previously from 1905 to 1927 dean of the School of Dentistry of the University of Minnesota, died on January 2 at the age of sixty-four years.

DR. FRANK STEWART KEDZIE, of the Michigan State College, died on January 5, at the age of seventy-eight years. Dr. Kedzie had been connected with the college since his graduation in 1877. He was professor of chemistry from 1902 to 1915; president from 1915 to 1921, and dean of the department of applied science from 1921 to 1927.

DR. CORNELIA M. CLAPP, since 1873 until her retirement in 1916 professor of zoology at Mount Holyoke College, and since 1897 trustee and emeritus trustee of the Woods Hole Marine Biological Laboratory, died on January 1 at the age of eighty-five years.

SIR JAMES ALFRED EWING, president and vice-chancellor of the University of Edinburgh from 1916 to 1929 and president of the British Association for the Advancement of Science in 1932, died on January 7, at the age of seventy-nine years.

A CORRESPONDENT writes: "Dr. A. Brožek, professor of genetics at the Charles University of Prague, died on November 8, at the age of fifty-two years. He had been since 1924 member and since 1930 fellow of the American Association for the Advancement of Science and was a member of the American Genetic Association. In the year 1924 he studied with Professor T. H. Morgan at Columbia University. Dr. Brožek worked on heredity and cytology in Limulus for twenty-three years and was the author of a textbook of genetics in Czech."

SCIENTIFIC NOTES AND NEWS

ACCORDING to the *Journal* of the American Medical Association, Dr. Henry Beeuwkes, of the staff of the Rockefeller Foundation, has been awarded the Mary Kingsley medal by the Liverpool School of Tropical Medicine in recognition of scientific accomplishment in research on yellow fever conducted in West Africa. At the ceremony in Liverpool, medals were awarded also to Sir George Buchanan, Sir Rickard Christophers and Sir Malcolm Watson. Dr. Beeuwkes was director of the West African Yellow Fever Commission, which studied yellow fever in Africa for nine years. During this period Dr. Hideyo Noguchi, Dr. Adrian Stokes and Dr. W. Alexander Young died of yellow fever contracted during the investigation.

PROFESSOR CHARLES A. SHULL, of the University of Chicago, was awarded the Stephen Hales Prize at the recent Pittsburgh meeting of the American Society of Plant Physiologists. Professor F. F. Blackman, of the University of Cambridge, was elected to the Charles Reid Barnes Life Membership; Professor V. N. Lubimenko, of the Botanical Garden of the Academy of Sciences, Leningrad, and Professor Gottlieb Haberlandt, of the University of Berlin, were elected corresponding members.

ON the occasion of the twenty-first annual meeting of the National Council of Geography Teachers, the Distinguished Service Award was presented to Professor A. E. Parkins, of the George Peabody College for Teachers, Nashville, Tenn. The award was established two years ago and the first recipient was the late William M. Davis, of Harvard University. Last year the award went to Professor R. H. Whitbeck, of the University of Wisconsin.

DR. ALEXANDER ZAHLBRUCKNER, formerly director of the National Museum in Vienna, has been elected an honorary member of the Linnean Society, London.

THE title of emeritus professor has been conferred by the University of London on Dr. E. G. Coker on his retirement from the Kennedy chair of civil and mechanical engineering at University College.

IT is reported in the *Journal* of the Washington Academy of Sciences that Dr. Paul R. Heyl, physicist of the National Bureau of Standards, was severely injured in an automobile accident recently, suffering the loss of his right arm.

DR. H. T. GUSSOW, Dominion botanist of the Department of Agriculture, Ottawa, was elected president of the American Phytopathological Society at the recent Pittsburgh meeting. Other officers elected were: *Vice-president,* F. C. Meier, of the Bureau of Plant Industry; *Secretary,* H. P. Barss, professor of botany, Oregon State Agricultural College; *Treasurer* and *Business Manager,* Dr. Howard A. Edson, head of the plant disease survey of the U. S. Department of Agriculture.

THE Genetics Society of America elected the following officers at its recent annual meeting: *President,* Dr. Donald F. Jones, Connecticut Agricultural Experiment Station, New Haven; *Vice-president,* Dr. P. W. Whiting, University of Pennsylvania; *Secretary-Treasurer,* Dr. M. Demerec, Carnegie Institution of Washington, Cold Spring Harbor, N. Y. Other members of the executive committee are two past presidents, Professor Sewall Wright, University of Chicago, and Professor R. A. Emerson, Cornell University.

AT the New York meeting of the American Society for Metals, B. F. Shepherd, chief metallurgist of the

Ingersoll-Rand Company, was elected president; R. S. Archer, chief metallurgist of the Chicago district of the Republic Steel Corporation, vice-president, and G. B. Waterhouse, professor of metallurgy at the Massachusetts Institute of Technology, a director.

AT the thirty-first annual meeting of the Association of American Geographers, which met under the presidency of Dr. Wallace W. Atwood at the University of Pennsylvania on December 27, 28 and 29, the following officers were elected: *President,* Professor Charles C. Colby, University of Chicago; *Vice-president,* Colonel C. H. Birdseye, U. S. Geological Survey; *Treasurer,* Professor John E. Orchard, Columbia University; *Councillor,* Professor Kirk Bryan, Harvard University, and *Secretary,* Professor Frank E. Williams, University of Pennsylvania. In the three-day session, forty-nine papers were presented. As retiring president, Dr. Atwood addressed the association on "The Increasing Significance of Geographic Conditions in the Growth of Nation States."

DR. ALEXANDER C. ABBOTT, emeritus professor of hygiene and bacteriology at the University of Pennsylvania, who will celebrate his seventy-fifth birthday on February 26, has resigned as a member of the Philadelphia Board of Health. Dr. Abbott was formerly president of the board and chief of the Bureau of Health.

WILLIAM G. BROWN, formerly assistant professor of aeronautical engineering at the Massachusetts Institute of Technology and last year chief engineer of the American Loth Company, has become a member of the department of aeronautics of the Louisiana State University.

DR. RAINER SCHICKELE has joined the teaching and research staff of the department of agricultural economics at the Iowa State College. Dr. Schickele has been conducting research for the Brookings Institution for the past six months at the college.

PROFESSOR ARTHUR ERNEST JOLLIFFE has been appointed fellow of King's College, University of London. He has been professor of mathematics in the college since 1924 and was formerly fellow and tutor of Corpus Christi College, Oxford, of which college, as well as of Jesus College, Oxford, he is now an honorary fellow.

D. Q. ANDERSON, of the Iowa State College, has been appointed research assistant at the Scripps Institution of Oceanography, the University of California, at La Jolla, to work with Dr. C. E. ZoBell in marine bacteriology.

DR. MARTHA EDITH MACBRIDE-DEXTER, of Sharon, Pa., has been appointed secretary of health in the cabinet of Governor George Earle, of Pennsylvania. She took office on January 15.

DR. WALTER REGINALD BETT, of the Royal College of Surgeons, London, has been appointed librarian of the Columbia University Medical School to fill the vacancy caused by the death in October of Alfred L. Robert.

MR. WALTER O. FILLEY, forester of the Connecticut Agricultural Experiment Station at New Haven, has been elected chairman of the Connecticut Committee on Dutch Elm Disease. Mr. Filley has also been appointed station representative to cooperate with the federal crew working on Dutch elm disease. Late in December Governor Cross approved an order, drawn up by Director William L. Slate, establishing two zones of infection in Connecticut and giving federal men permission to remove dead or dying elms, as well as trees with Dutch elm disease, in these areas. In the spring the station plans to carry on an intensive survey of elms in parts of the state not covered by the federal crew.

THE *Museum News* states that D. T. Ries, formerly curator of education and entomology at the Cranbrook Institute of Science, Bloomfield Hills, Mich., is now resident at Cornell University, where he is engaged in entomological research and is working on the completion of a series of outlines of science for children.

DR. HENRY V. HOWE, of the Louisiana State University, has been appointed adviser to a geological survey of the state to be undertaken by the Department of Conservation.

DR. RANDOLPH WEST, associate professor of medicine at Columbia University, recently conducted a series of clinics and lectures before the faculty and hospital staff of the School of Tropical Medicine, Puerto Rico. A lecture on "The Relation of Pernicious Anemia, Sprue and Pellagra" was given at the annual meeting of the Puerto Rico Medical Association.

PROFESSOR HARLOW SHAPLEY, director of the Harvard Observatory, gave the Harris Foundation Lectures at Northwestern University from January 9 to January 16. The lectures, six in number, were open to the public. The general subject of the lectures was "Exploring the Galaxies." The subjects of the individual lectures were: "The Seven-Zoned Census"; "Methods and Machinery"; "The Confusing Milky Way"; "The Clouds of Magellan"; "Galaxies-Types and Activities"; "The Metagalaxy."

DR. DONALD F. JONES, head of the department of genetics of the Connecticut Agricultural Experiment Station at New Haven, has accepted an invitation to

give the Spragg Lectures at Michigan State College, during the week of February 11. He will speak on "Genes, Present and Missing," "The Interpretation of Hybrid Vigor," "The Production of Inbred Strains of Corn" and "The Testing and Utilization of Inbred Strains of Corn."

THE fifth series of the Charles Sumner Bacon Lectures was delivered on January 16, 17 and 18 at the University of Illinois College of Medicine, by Professor Ludwig Fraenkel, head of the department of gynecology and obstetrics at the University of Breslau.

DR. HUGH L. DRYDEN delivered the address of the retiring president of the Philosophical Society of Washington on January 5. He spoke on "The Frontiers of Aerodynamics."

AT Yale University Dr. Eleonora B. Knopf recently gave, under the auspices of the department of geology, a series of six lectures on "Petrofabric Analysis," describing the technique devised by Sander and Schmidt, by which the three-dimensional arrangement of minerals in rocks is determined quantitatively.

REXFORD G. TUGWELL, Under Secretary of Agriculture, will be a speaker with Governor Lehman at the annual dinner of the New York State Agricultural Society at Albany, on January 23. Dean Carl E. Ladd, of the State College of Agriculture, will speak at the State Capitol in the morning and Lithgow Osborne will speak in the afternoon.

THE second centenary of the Spanish National Academy of Medicine, founded in September, 1734, was celebrated in Madrid from December 10 to 15.

THE General Assembly of the European Federation of Engineers' Associations will be held in Rome in May.

A JOINT meeting of the American Physical Society and the Optical Society of America will be held at Columbia University in New York City, on Friday and Saturday, February 22 and 23. Additional sessions may be scheduled for Thursday, February 21, if warranted by the number of contributed papers. In addition to the usual program of papers contributed by members there will be a joint session devoted to invited papers on atmospheric optics. The meeting will be open to non-members as well as members of the societies. A joint dinner will be held on Friday evening, followed by an evening lecture.

THE annual spring meeting of the New York Branch of the American Psychological Association will be held on April 13 at Princeton University. The general program will consist of parallel sessions running from 9:30 to 12:30 A. M. and from 2:00 to 5:00 P. M. The address of the honorary president, Dr. Joseph Jastrow, will be given in the evening following a dinner.

APPLICATIONS for telephone engineer and telegraph engineer positions of various grades in the Federal Communications Commission must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than January 30, 1935. The salaries for telephone engineer range from $3,000 to $5,600 a year and for telegraph engineer from $2,600 to $4,600 a year. These salaries are subject to the usual deductions. The work will be in connection with the performance, or supervision of the performance of, engineering studies and investigations on wire telephone or telegraph systems and their component parts.

A LIMITED number of scholarships for qualified graduates in medicine who wish to do graduate study, especially in internal medicine, are available at New York Post-Graduate Medical School, Columbia University. By the terms of the endowment, applicants from Allegheny County, Pennsylvania, will be given preference, other circumstances being equal. Application should be made to the director of the medical school, 303 East Twentieth Street.

DR. C. G. JUNG, of Zurich, has presented 200,000 Swiss francs to the Higher Technical School of Zurich to form a fund for the advancement of psycho-analysis and allied studies.

SIR DOUGLAS ALEXANDER, president of the Singer Manufacturing Company, has made a gift of $10,000 to the Massachusetts Institute of Technology, of which $5,000 has been allotted to the construction of a large calculating machine for the mechanical solution of simultaneous algebraic equations. A laboratory model of the machine, which was designed by Professor John B. Wilbur, of the department of civil engineering, was recently completed. The chief use of this machine will probably be found in the analysis of stresses in various types of engineering structures, such as buildings, bridges and airplanes. Other applications can be made in such diverse fields as surveying and psychology. The balance of the fund has been allotted to the initial equipment and operation of a new laboratory for research and testing in the field of dynamic strength of materials. This work will be under the supervision of Professor A. V. de Forest in the department of mechanical engineering, who joined the staff last October.

THE William G. Bixby nut arboretum, Baldwin, L. I., has been purchased by the Federal Government. The trees have been apportioned among the new National Arboretum in Washington, D. C.; the Forest Service Nursery at Troy, N. C., and the Division of Forest Pathology. In the latter division some 1,000

disease resistant chestnuts will be distributed for re forestation to replace the large number of trees which have been killed by the devastating blight along the Atlantic seaboard The trees include black and Japanese walnuts, butternuts, sweet hickory, shagbark, shellbark, bitternut, pignut hickory, Chinese, Korean, Japanese and European and Turkish filberts and hybrids of many varieties and species The cost of transplanting was made possible through emergency conservation funds

UNDER the will of Mr Reginald Radcliffe Cory, of Wareham who died on May 12, leaving an estate of the gross value of £221,809, a substantial residue of the property is left to the University of Cambridge for the general interests of the botanical gardens Mr Cory directed that the income from £30,000 of the residue should be expended in the upkeep of the botanical gardens and the payment of salaries of those employed in, or in connection with, the gardens

ACCORDING to the *Museum News,* the Museums Association of Great Britain has made the following allotments, from the Carnegie Corporation grants, to colonial museums in the Empire one thousand pounds to the Cyprus Museum, Nicosia, Cyprus and the Barbados Museum and Historical Society Bridgetown, Barbados, five hundred pounds to The Museum Georgetown British Guiana (in addition to twenty thousand pounds for library and museum extension) and to the Nelson Museum Antigua, four hundred pounds to the Achimota College Museum, Accra, Gold Coast, two hundred pounds to the Rhodesian Museum, Bulawayo, S Rhodesia, The Queen Victoria Memorial Library and Museum, Salisbury, S Rhodesia, St John's Co Cathedral Museum, Valetta, Malta, the Library and Museum Committee, Falkland Islands, and the Museum of the Mauritius Institute, Port Louis

A NEW journal, entitled *The Botanical Review,* edited by Drs H A Gleason and E H Fulling, of the New York Botanical Garden, the first number of which appeared this month, has been announced The preliminary announcement states that "No original research will be presented, but each article will collate, summarize and evaluate all recent important work on the topic" The advisory editors are *Paleobotany* Professor R W Chaney, University of California *ecology* Professor W S Cooper, University of Minnesota, *anatomy* Professor A J Eames, Cornell University, *mycology* Professor R A Harper, Columbia University, *taxonomy* Dr F W Pennell, Philadelphia Academy of Natural Sciences, *cytology* Professor L W Sharp, Cornell University, *genetics* Professor E W Sinnott, Columbia University, *psychology* Professor Gilbert Smith, Stanford University, *pathology* Dr N E Stevens U S Department of Agriculture, *morphology* Professor R B Thomson University of Toronto, and *physiology* Professor S F Trelease, Columbia University

THE program of the fifty third course of popular medical lectures being given by Stanford University School of Medicine on alternate Friday evenings, from January 4 to March 15, is as follows 'Brain Activities," Dr James M D Olmsted, 'Poliomyelitis," Dr Harold K Faber, Dinitrophenol in the Control of Obesity," Dr Maurice L. Tainter, 'Quinine The First Hundred Years," Nathan Van Patten, director of University Libraries, 'Present Day Relationships Between Medicine and Industry," Dr William P Shepard, and 'Growth and Development in Infancy," Dr Mary H Layman

DISCUSSION

THE DUTCH ELM DISEASE, GRAPHIUM ULMI IN CONNECTICUT

THIS fungous disease was first found in Connecticut in the fall of 1933 A short account of it, up to the first of April, 1934, was published in Bulletin 358, page 305, of the Plant Pest Hand Book of Connecticut Since then the finding of over 50 infected trees in the state and especially in Old Lyme, some fifty miles from the center of the infected area near the New York state boundary, from where the fungus apparently first spread into Connecticut, has aroused outside interest Information concerning the disease and its control, therefore, has been requested, especially from the New England states

A good many people believe that if the disease is not eradicated in Connecticut it will spread generally throughout New England, where many of the most valuable elms in this country are found and cause serious injury or death of the same Certain of these people also believe that Connecticut, with its fewer infected elms and with a quicker start for control after its discovery than was the case in New York and New Jersey, has a better chance to stop its further spread into new territory to the east and north

So far the only method tried by the government or the states, for either eradication or control, is the cutting down and burning of infected elms Just how effective this will finally prove remains to be seen So far, judging from results obtained in New Jersey, it does not seem to be entirely efficient either as regards cost or control, since large sums of money have been spent and there were still left standing at the

end of 1934 more infected trees than those known to have been infected at the end of 1933, despite the many trees removed in both 1933 and 1934. No one knows, moreover, how many undiscovered trees became infected in 1934 in New Jersey, New York and Connecticut; in fact, it seems that effort, so far, has been to follow up the disease at a slower rate than it advanced ahead of the control method applied.

As a result of our studies and experience with this and other tree diseases, the authors of this article believe that the time is now past when either this fungus or its insect carriers can be eradicated in the United States. We are, furthermore, of the opinion that the general destruction of infected trees and those dead or dying from other causes in the infected region of these three states and especially of forest trees, particularly in swampy land, may not be the best or most economical way of dealing with this trouble.

We believe that eventually the problem will result in a cheaper and a more practical way by limiting protection to our city, residential and highway trees. This may include better care of such trees against other injurious troubles and search for some new method for control of this one but limiting destruction of the trees, whether infected or not, until their usefulness is past their prime and especially by obtaining more complete information concerning trees sickly from other causes as to how important a factor they may be in the spread of the Dutch elm disease.

In the meantime we countenance the U. S. Government's rather ruthless and expensive plan of doubtful eradication or at best possible control by cutting down all dead and dying trees in the infected area up to the end of the summer of 1935, when more certain evidence should then finally decide how effective this plan has been. The extra money recently appropriated by the U. S. Government and that already supplied by the states, or to be supplied by them, should be sufficient to carry out this plan.

So much for general statements. The preliminary investigation of the Dutch elm disease in Connecticut, which up to the end of 1933 was entirely a matter of the botanical department, has now been assigned by the director to the departments of forestry, entomology and botany, chiefly according to their various interests.

Beginning soon after the first of August, three crews (each with two practical tree workers, previously engaged by the U. S. forces under Mr. L. R. Fate in the Greenwich-Stamford section, and each with an auto to aid in the scouting) were employed by the station to make a somewhat hurried survey of the state outside of the infected district in Fairfield County. The first of these crews took in Fairfield outside of the government surveyed area and the rest of the state east to the Naugatuck River and north to the Massachusetts line. The second crew scouted from this line east to the Connecticut River; while the third crew took the rest of the state east of the Connecticut River to Rhode Island. These crews worked until the end of September. As a result of their and the Government's inspections every one of the 169 towns of the state was visited, but only one infected tree was found outside of the known invaded area—the one at Old Lyme.

In the meantime Mr. Fate, of the U. S. Department of Agriculture, continued his careful search of the five invaded towns and their adjacent free towns in Fairfield County, but with a reduced force because of decreased Government funds. His final results for the year 1934 showed 56 infected trees in this area. Our department has verified about 40 per cent. of the elm trees, reported by the U. S. Department of Agriculture to Mr. Fate, in this infected area, embracing the towns of Greenwich (36 infected trees), Stamford (9), Darien (8), Norwalk (1) and Fairfield (2). However, in the last town we failed to obtain cultures from the two young trees reported there, though at least three attempts were made from one of them but always with negative results so far as *Graphium Ulmi* was concerned.

With the single old tree found outside of the area in Fairfield County located by the station's scouts—namely, about 50 miles distant at Black Hall, Old Lyme—not only were cultures obtained from the twigs, the old diseased bark and the wood (later verified by the U. S. Department of Agriculture), but also the fruiting stage of the Graphium was found more abundantly in the dead bark than in any other tree in Connecticut to date. The foreign beetle carrier, *Scolytus multistriatus* Marsh, was not present in this tree or apparently in its general region. However, a native beetle and its larvae, *Hylurgopinus rufipes* (Eich.), determined by the station's entomological department, was present.

These two stages of Hylurgopinus and mites, also present, were found to be local carriers over the infected bark, since all of them taken from the bark were able to transfer the Graphium to media in Petri dishes. Furthermore, the mature beetles were found to be possible carriers of the disease to healthy trees, since when placed in test-tubes with healthy twigs of elm the latter became infected the same as has been shown before with *Scolytus multistriatus*, the common carrier here.

The Hylurgopinus beetles for this experiment were taken from the infected bark in the Old Lyme tree and carried in bottles to New Haven and then placed in test-tubes with local healthy elm twigs that had

been previously sprayed with alcohol and burned to kill most of the adhering spores of saprophytic fungi. In some 20-odd cases in different tubes, the coremial stage of *Graphium Ulmi* appeared on at least 75 per cent. of the twigs. In about a dozen different tubes, where such beetles from dying elms not killed by the Graphium were used, the fungus did not appear on any of the twigs. This does not mean, however, that such beetles might not carry the disease from diseased trees to those dying from other causes.

Our experiments, however, indicated that the *Hylurgopinus rufipes* is a probable carrier in nature. How much this beetle injures the young twigs in the early season we do not know, but in our experiments the beetles chewed the bark and even at times entered somewhat out of sight in the twigs. It is, however, up to the entomologists to show what injury this beetle does to the elm twigs in the early summer. It is also up to them to demonstrate how commonly beetles go from infected trees to those dying from other causes. If this can be shown as a common occurrence, then there is a more definite reason for getting rid of such non-infected trees, as far as control of the fungus is concerned. In Europe besides *Scolytus scolytus* and *S. multistriatus*, *S. sulcifrons* has recently been claimed as a carrier of *Graphium Ulmi* to elms in Italy.

The station's scouts, in the state outside of the infected area in Fairfield County, reported over 50 dead or dying elms showing tunnels of either Hylurgopinus or Scolytus. We examined practically all these, and as many more with or without beetle tunnels, for indications of *Graphium Ulmi* in the dead bark, but in no case was this found. However, we did find in some of them a saprophytic Graphium, with spores finally dark in mass, and in one or two cases what seemed to be the immature asco stage of it. So far the asco stage of *Graphium Ulmi* has not been found in nature in this state; however, in cultures, imperfect developments of it have been seen rarely in certain test-tubes.

This survey of dead elms is valuable in what it may show later when *Graphium Ulmi* invades this free territory. A less extensive but similar examination in the infected Greenwich-Stamford area also failed to reveal the fruiting stage of *Graphium Ulmi* on the dead or dying bark of elms dying from other causes. Both inspections were made about the same time in the fall. Further observations, however, need to be made before we can be sure of the value or uselessness of removing dead trees or limbs, dying from other causes, as a means of limiting the direct spread of *Graphium Ulmi*.

We have been able in a fair number of the cases tried to produce the coremial stage of *Graphium Ulmi* by spraying pure cultures of the spores on the inner bark of the elm in moist chambers. So far, apparently, the healthy bark has given better results, though we have had some infections on beetle-injured, rotting bark.

Dr. L. B. Arrington was temporarily hired for superintending the tree survey work for the station and proved very satisfactory. All the infected trees found in Connecticut have been removed and destroyed. This eradication has been done under the direction of W. O. Filley, the station forester. Just how effective this apparently complete control work has been remains to be seen when possible new or undiscovered infections show next summer.

G. P. CLINTON
F. A. MCCORMICK
CONNECTICUT AGRICULTURAL
EXPERIMENT STATION

THE BELGIAN NATIONAL RESEARCH COUNCIL

AT a time when the support of scientific work and the place of science in national planning is a subject of discussion, the sixth annual report of the Belgian *"Fonds National de la Recherche Scientifique"* is especially interesting. This foundation, with a capital of approximately $6,000,000, was started in 1927 by contributions from many private and industrial sources under the enthusiastic support of the late king. To form an estimate of the relative importance of the foundation, the reader should multiply the figures in this review by fifteen, the ratio of the populations of the United States and Belgium. Of the income of $350,000 in 1933, about half was devoted to subsidies in aid of pure scientific and scholarly investigations (philosophy and letters as well as law are included). The industries were, however, not neglected, as grants of $55,000 were also made in aid of twelve projects. In general the foundation expected the industry interested to contribute half of the cost of the investigation on the theory that "a business man is apt to think that what costs him nothing is not worth much."

The $175,000 devoted to pure science was distributed in a manner that has many novel features. Forty per cent. or $70,000 was given for the equivalent of our national research fellowships. These fellows, 68 in number, are appointed for two-year periods, which are renewable up to six years. The stipend increases from $1,000 to $1,200, and the number of fellows shows a gradual and natural decrease for successive years of tenure (20, 16, 12, 8, 8, 4).

The policy guiding the foundation is stated as follows: "To endeavor to assure the continuity of scientific effort in our country, and to provide for the

recruiting and development of the personnel in advanced teaching and research positions" The support of selected fellows for long periods at a low stipend undoubtedly favors the gradual and natural absorption of these men into the various institutions of the country How often have we seen a young man come to the end of a two-year fellowship with an investigation well under way, and then, for financial reasons, accept some position where his scientific work must be dropped!

The novel features are still more striking in the disposition of the remaining 60 per cent of the funds Subsidies amounting to $28,500 were granted to 23 "associates" These "associates" are men of an established scientific reputation who are on the regular staffs of universities or institutes, the subsidy allowing them to go on a 'part time" basis, so that they may have time and energy to continue their investigations The total salary, however, is never allowed to exceed that of their colleagues on a full time basis In this way the foundation endeavors to counteract some of the undesirable results of the system of regular routine promotion and emphasis on teaching which has ruled in the Belgian universities

Partly due to the policy of the Fellowship Board of the National Research Council we have tended to concentrate scientific work in a few institutions This is doubtless a wise policy in dealing with young men who gain very much from association with a group of active co workers But science can not exert the proper influence on the educational life of the country if it is confined to a few research institutes It is easy to imagine the effect of a policy such as that followed by the foundation with its 'associates," in giving prestige to serious, scholarly and scientific work in all the institutions of the country and weaning them gradually from contentment with lesser ideals

A third category contains subsidies to investigators "who have won distinction by their scientific work" Thirty two received $25,300 for financial assistance in carrying out various investigations, $10,400 was distributed to 32 applicants for expenses in traveling and visiting laboratories in different countries, and $10,000 was used in paying technical assistants for 13 scientists

In addition, apparatus costing $26,500 was purchased and loaned to various investigators This apparatus remains the property of the foundation which, as the result of purchases in preceding years, now has at its disposal apparatus valued at $160,000

The foundation also provides annually a sum of $31,250, which is devoted to paying life annuities, not exceeding $1,250 each, to certain distinguished scientists, selected apparently on the basis of the prizes and honors that have been awarded to them As the report explains 'The council considers it its duty to create for certain particularly eminent men of science a position worthy of the rôle that they play in the moral and material development of the country" The recognition of such a group probably emphasizes the diversified character of scientific advance and the fact that constant effort is called for on all fronts

It is apparent that in Belgium the national importance of sustained scientific work and the continuous selection and development of able men in the institutions of the country is vividly realized, and measures are being taken which far exceed in relative magnitude any analogous ones in our country

A J Dempster

University of Chicago

OAK TREES AND THE WHITE GRUB MENACE

The southern half of the state of Wisconsin is characterized by an oak hickory climax forest This area coincides closely with the estimated areas of severe grub damage to pasture and corn land Further, most of this injury is caused principally by the grubs of four species of June beetles which have a marked preference for certain varieties of oak, notably bur oak It would appear that a correlation exists in nature between the abundance of certain injurious species of white grubs and certain preferred adult food plants

In the choice of trees for propagation, either on a small scale or on a gigantic scale such as the U S Shelter Belt project, each variety should be considered in relation to its relative attractiveness as June beetle food not only from the standpoint of the successful establishment of the young trees but also from the standpoint of the possible associated increase of harmful insects, such as white grubs The same extremely harmful species of June beetles so abundant in Wisconsin which have predominant oak feeding preferences are now present in small numbers in at least part of the area to be crossed by the proposed shelter belt If conditions are made more favorable for these and other pests future farmers may face conditions just as serious as drought

C L Fluke, Jr.
Paul O Ritcher

University of Wisconsin

THE BIOLOGY OF THE BLACK WIDOW SPIDER, LATRODECTUS MACTANS[1]

During the past three years the writers have made numerous collections of the black widow spider in Ravalli County, Montana During this period there

[1] Contribution from the Rocky Mountain Laborato y of the U S Public Health Service, Hamilton, Montana.

has been a continuing infestation in the main buildings and outbuildings of the Rocky Mountain Laboratory of the United States Public Health Service at Hamilton, and the spiders have been occasionally found in residences within the city. However, they have been most frequently met with in the burrows of the Columbian ground squirrel, *Citellus columbianus*.

During the spring and summer the spiders are found in or at the margin of irregular webs stretched across the openings of the ground squirrel burrows, especially of those which are deserted. When disturbed they retreat to the walls some distance back from the opening. This habitat is favorable because of rather plentiful and constant insect fauna which is associated with the underground tunnels and nests.

The underground conditions are also well suited for successful hibernation, since the burrows extend below the usual frost line. During the excavating of squirrel nests in November and December, 1932, after the surface soil was frozen, spiders were found deep in the burrows. Immature specimens, as well as males and females, were found in the tunnels and nests.

This spider has also been encountered in abundance in the semi-arid, unirrigated bench lands of the Yakima Valley in Washington, where characteristic webs, egg cases, spiderlings and females were found in the openings of abandoned warrens of cottontail rabbits.

These observations suggest that rodent burrows form an important natural habitat for the breeding and hibernation of *Latrodectus mactans* in the northwestern states.

WM. L. JELLISON
C. B. PHILIP

A NEW SOUTH DAKOTA METEORITE

THE South Dakota State School of Mines recently came into possession of an iron meteorite found in the spring of 1934 on the W. L. Dale ranch located at the head of Black Pipe Creek in northeastern Bennett County, South Dakota. The specimen was unearthed by a farm helper while disking a field in planting corn. The field had been cultivated for several years, and nothing unusual had been observed. The disk struck the meteorite, the impact producing a peculiar sound and this led to investigation, including some digging. The conditions were much as might be expected in connection with any field stone, and there were no observable signs of the meteorite having fallen recently. The specimen was found in the northeast corner of the southeast quarter of section 32, township 33, range 39. This is approximately 35 miles northeast of Martin, the county seat of Bennett County, and 10 miles south and 3 miles west of the post office of Norris.

The meteorite, designated as the Bennett County meteorite, is a smooth, compact, irregular saddle-shaped mass 16 inches (407 mm) long; 12 2/3 inches (321 mm) wide; and 10 1/2 inches (267 mm) high in the highest part, measured perpendicular to the somewhat flat base. Its weight as found was 195 pounds 11 ounces. Much of the surface is pitted. A considerable part of it has a smooth, somewhat shiny and nearly black surface, while other parts, particularly the base, is largely covered with a brownish-yellow oxidized coating. An analysis of unoxidized drillings shows the contents as follows: iron, 94.26 per cent.; nickel, 5.25 per cent.; cobalt, 0.46 per cent.; sulphur, 0.04 per cent. The analysis does not indicate carbon, but microscopic examination discloses occasional small particles of graphite. In addition to the nickel-iron alloys polished surfaces reveal numerous small inclusions of triolite. Some of the triolite is in the form of nodular inclusions and some of it in thin veins. Polishing and etching reveal coarse Widmanstatten figures, but further study of the structure is necessary before the meteorite can be definitely classified as to type.

CLEOPHAS C. O'HARRA
SOUTH DAKOTA STATE SCHOOL OF MINES

GROUND WATER AND FOREST BELT

PROFESSOR H. J. LUTZ, of the School of Forestry, Yale University, has kindly called my attention to an error in the statement of one of the illustrations used to emphasize the importance of a sound basis of scientific knowledge as prerequisite to any proper program of national planning in respect to natural resources.

On page 390 in SCIENCE for November 2, 1934, I stated:

> Again, scientific study has recently shown that, if the number of trees per acre is reduced below a certain minimum in the yellow pine belt just east of the Cascade Mountains, then the ground water level drops and the country becomes a desert.

It is well known that the ground water level is lower beneath a forest than it is under most other types of vegetation. The effect of cutting a forest is not in general to lower but to raise the water table. I am informed that the natural spread of the forest belt east of the Cascades in central Oregon is initially promoted not by a favorable change in the ground water but because of an irregularly recurrent increase in surface moisture which provides both seeds and seedlings especially favorable opportunities for growth.

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SCIENTIFIC BOOKS

INFANT BEHAVIOR

Atlas of Infant Behavior: A Systematic Delineation of the Forms and Early Growth of Human Behavior Patterns. By ARNOLD GESELL. Vol. I—Normative Series, in collaboration with Helen Thompson, and Vol. II—Naturalistic series, in collaboration with Alice V. Keliher, Frances Lillian Ilg and Jessie Jervis Carlson. 921 pages. Yale University Press, New Haven, Conn. 1934. $25.00.

IN these well-planned and extraordinarily well-printed volumes, Arnold Gesell, who for three decades has pioneered in research on the infant and young child, presents thirty-two hundred photographs, enlarged from motion picture frames, delineating the behavior of infants during the first year of life. Those in the first volume, taken in the photographic dome of the Yale Psycho-Clinic under laboratory conditions, show the development of 24 behavior sequences which cover posture, locomotion, perceptual, prehensive and adaptive behavior at 4, 6, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48 and 52 weeks, respectively. For instance, there is a series of photographs showing the behavior of an infant while sitting, another showing stair climbing, another showing behavior in the ring and string situation.

The enlargements in the second volume show the behavior of infants in naturalistic situations—*i.e.*, under a duplication of home conditions, in a special studio room to which both the infant and the mother, who was present, have been habituated. One purpose of the second volume is the portrayal of individual differences in development. The behavior situations and episodes illustrated center about feeding, bathing, posture, social behavior, play and locomotion. Each volume contains a description of the methods of securing and treating the films and of the apparatus, cameras and observation chambers used. Each photograph in a sequence is accompanied by a brief verbal description and is timed—*i.e.*, the time elapsing from the beginning of the particular response is stated.

In the first volume the pictures are arranged by behavior patterns in age sequences; in the second volume by children. Both volumes are loose-leaf with the photographs printed on only one side of the page to facilitate rearrangement for cross comparison in accordance with the reader's interests. Thus all the pictures dealing with the development of eating or bathing habits can be put together. The excellent quality of the enlargements in the first volume is exceeded by those of the second volume—indicating the superiority of 35 mm over 16 mm film.

The approach to the study of infant behavior as presented in the atlas is so new that its evaluation is difficult. There is no doubt of its vivid and striking portrayal of infant behavior and its worth for teaching and demonstration and for directing the attention of scientists, students, parents, artists and other workers to various aspects of infant development. Only the future can determine its scientific value. The statistical data necessary for the interpretation of the normative and naturalistic pictures are not given. Nor is it clear how a particular picture or sequence was selected as normative. On the other hand, taken as a whole, rather than examined critically in detail, the sequences give a graphic and total picture of development that may for some purposes be of more value than the fractionating of behavior into minute parts to which we have become so accustomed.

Gesell states (p. 41) that the atlas is offered as "a systematic collection of specimens of infant behavior patterns," and goes on: "In format, arrangements, and mechanical makeup both volumes are designed to make this collection useful for conducting both analytical and comparative studies. Interpretive comment is withheld and the course of the behavior alone is described." The atlas therefore presents the material from which scientific conclusions may be drawn without itself actually generalizing. This raises an interesting question. Is the description of behavior in verbal terms or with the aid of fine instruments, such as the cinema, any more than the presentation of raw data? A partial answer is found in the fact that the pictures presented in the atlas were selected by one of the outstanding students of infant behavior from millions of cinema frames available in the Yale Psycho-Clinic. In the introduction to the atlas, Gesell mentions another publication, entitled "Infant Behavior: Its Genesis and Growth,"[1] which contains an exposition of the findings of the normative research and which he says may be used as a detailed handbook for the interpretation of the illustrations in the atlas.

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UNIVERSITY OF MINNESOTA

MATHEMATICAL PHYSICS

Principles of Mathematical Physics. By WILLIAM V. HOUSTON. Pp. xi + 265. McGraw-Hill Book Company, Inc., 1934.

THIS book is a text of intermediate grade designed to give the college student specializing in physics a working knowledge of the fundamental methods of mathematical physics, without attempting any elaborate exposition of physical theories. A thorough knowledge of elementary physics on the part of the

[1] Arnold Gesell and Helen Thompson, "Infant Behavior: Its Genesis and Growth." McGraw-Hill, New York, 1934. 343 pages.

student and a familiarity with analytical geometry and calculus is assumed.

Subjects treated include mechanics, thermodynamics, electricity and magnetism, together with a short discussion of the special or restricted theory of relativity. Mechanics is emphasized not only because it furnishes fundamental concepts for all other branches of physics, but also because its development provides examples of a number of important mathematical methods. The treatment of Hamilton's principle and the discussion of Gibbs's statistical mechanics, in particular, although not elaborate, are very satisfactory. On the other hand, more space could well be devoted to thermodynamics, and the same is true to a less extent in connection with the portions of electricity and magnetism dealing with material media.

In addition to the above, chapters are devoted to differential equations, calculus of variations and vector analysis. The treatment of these subjects, although compact, is clear and should be very useful to the student of physics with only the average preparation in mathematics. No attempt is made to develop any of the various subjects in great detail, much being left to the student in the form of problems, of which there are a large number. For those interested in collateral reading an excellent list of references is appended to each chapter.

The most serious defect in the book is the almost entire lack of figures. There are but three altogether, although at many points a figure would undoubtedly be an aid to the student's comprehension of the analysis.

"Principles of Mathematical Physics" should prove satisfactory as a basic text in a lecture course introducing mathematical physics and also should be of value as an auxiliary in more advanced courses, particularly in the field of mechanics, as there are a number of items included here which are often omitted from other texts. The book is not well suited, however, to independent study by the average student, as supplementary physical background should be supplied in many places.

N. I. Adams, Jr.

Yale University

SCIENTIFIC APPARATUS AND LABORATORY METHODS

INTRATRACHEAL INOCULATIONS IN THE RAT[1]

As a preliminary step in the study of lobar pneumonia in the rat, the following method of intratracheal inoculation has been developed.

The anesthetized animal is placed on its back with the head at the edge of the table and held by an assistant, who grasps the tongue with a hemostat. Traction is applied to the tongue so that it is held firmly to the side of the mouth and against the lower teeth. The root of the tongue is raised by spreading the blades of a curved hemostat inserted far back in the pharynx and held by the operator. The field is illuminated by reflected light from a head mirror. Under direct vision a specially devised cannula may then be inserted into the trachea.

The cannula is made of brass tubing 7 cm long, 2.5 mm outside diameter and 1.6 mm inside diameter. The tube is bent upward at an angle of 15°, 0.5 cm from the distal end. The tip is beveled on the upper surface, care being taken to avoid sharp edges. Near the proximal end of the tube a brass rod 5 cm long and 3 mm in diameter is soldered at right angles to serve as a handle.

To enter the trachea, the beveled tip of the cannula is placed just under the epiglottis, which is then raised slightly. The handle of the instrument is depressed and the cannula passed gently into the trachea. When the cannula is in the trachea a drop of soap solution placed over the proximal end will form soap bubbles which break explosively. If the cannula has entered the esophagus bubbles may form but do not break with expiration. This test is important.

In the final step of the procedure a No. 5 French ureteral catheter (1.5 mm in diameter) is passed through the lumen of the cannula and withdrawn 0.5 cm at the first sense of resistance. This serves to free the tip of the catheter. Up to 0.5 cc of material may be injected from an attached syringe.

After an experience of over 300 inoculations made by this method, it is believed that with limited practise one should be able to make successful inoculation in at least 95 per cent. of the trials. Guinea pigs may also be inoculated by this method, although greater difficulty is encountered in passing the cannula into the trachea.

L. Jourdonais
W. J. Nungester

[1] From the Department of Bacteriology, Northwestern University Medical School, Chicago, Illinois. Aided by a grant from the American Medical Association.

THE PRESERVATION OF CARTILAGE

This technique was evolved to obviate certain difficulties in handling the cartilaginous structure of a chimaeroid fish, *Hydrolagus colliei* (Lay and Bennett). In this case the cleaned cranium was dehydrated by ordinary histological methods. After it had been placed in paraffin, the temperature of the

paraffin was raised until it was quite liquid, and then the cranium was removed and wiped clean. At the present the cranium has been exposed to such desiccation as would occur on my desk for quite some time, and there is absolutely no sign of shrinkage or alteration. This process would be applicable to the cartilaginous structure of any of the smaller elasmobranchian fishes, for there is an evident limit in the size of the cartilage to be impregnated; although the degree of infiltration necessary to preserve the cartilage would be below the standard required in microtechnical work. The cranium is in a condition for study far superior to cartilaginous material in liquid preservatives.

V. BROCK

STANFORD UNIVERSITY

PERMANENT ACETO-CARMINE PREPARATIONS

THE following method has proven useful in accurately and permanently preserving the cytological details in aceto-carmine preparations. It is rapid and convenient and has been found more satisfactory for our purposes than previous techniques.[1]

The preparation is made in the usual way[2] and sealed with vaseline or preferably paraffin. When the stain is satisfactory the slide is supported face down by two thin glass rods in a petri dish of a mixture of equal parts of xylol, absolute alcohol and glacial acetic acid until the cover soaks loose. The action of the reagent is hastened by first cracking off most of the paraffin seal with a needle and also by gentle agitation of the slide.

When the cover comes off (5 minutes to ½ hour) the slide is rinsed in the solution for 5 minutes, drained carefully and wiped free from mounting medium. It is then passed through two changes of a mixture of equal parts of xylol and absolute alcohol (5 to 10 minutes each), then through xylol (10 to 15 minutes) and mounted in balsam. The xylol stage may be omitted with minute objects such as pollen-mother cells. Occasionally part of the preparation adheres to the cover slip in which case cover and slide are run up separately and recombined in balsam. Preparations in the balsam improve in clarity for a week or more. Smears of pollen-mother cells (*Lilium*, *Podophyllum*, *Hyacinthus*, *Tulipa*) made in this way are unaltered 10 months after preparation. The method has been used successfully on smear preparations of Dipteran salivary glands (*Drosophila*, *Sciara*, blowfly).

Professor C. W. Metz and Miss Elizabeth Gay find the following modification equally as good as the above for paraffin-sealed smears of *Sciara* salivary glands: Soak off the cover in equal parts of 95 per cent. alcohol, clove oil and glacial acetic acid; 2 changes of 95 per cent. alcohol up to ½ hour; absolute alcohol 5 minutes; clove oil 10 minutes; xylol 5 minutes; balsam.

JOHN B. BUCK

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[1] B. McClintock, *Stain Tech.*, IV: 53, 1929; W. C. Steere, *Stain Tech.*, VI: 107, 1931.

[2] Lee, "Microtomist's Vade-Mecum," p. 142, 9th ed., 1928; J. Belling, *Am. Nat.*, 55: 573, 1921; *Biol. Bull.*, 50: 160, 1926.

SPECIAL ARTICLES

THE SIMILARITY BETWEEN FASCIATIONS IN PLANTS AND TUMORS IN ANIMALS AND THEIR GENETIC BASIS

A COMMONLY recurring abnormality in plants is the irregular development of the growing points of the main stem or branches called fasciations. These peculiar formations occur in many plant families and are particularly noticeable in species having an indeterminate type of growth. In some cases fasciated plants are able to reproduce and all the progeny show the same abnormality. In these cases the teratological development is due to one or more specific genes for abnormal growth and is definitely inherited. In many other cases fasciations occur only in one part of a plant. Such variations occur so sporadically both in seed and vegetatively propagated plants that they seem not to have any basis in inheritance, yet they appear more frequently in some germinal lines than in others. Gall formations occur in plants, and many of these are clearly due to insect, fungus and bacterial parasitism. In some galls no infection can be found and these seem to be a form of unregulated growth for which no adequate explanation has been made.

The tumors in animals that assume many different forms and occur in many parts of the body are also a form of unregulated growth. This abnormal development frequently starts in traumatic tissue. In both plants and animals the injurious nature of unregulated growth comes mainly in later stages from a breaking down of cells due either to pressure or to a failure of normal metabolism, resulting in secondary infections in necrotic tissue. Plants differ from animals in that there is no migration of abnormal cells to other parts of the organism starting new centers of growth. In plants there is no circulatory system whereby this transfer could be brought about. Fasciations and galls in plants do not show the malignant features characteristic of many tumors in animals.

Other differences in atypical growths in plants and animals arise from fundamental differences in development.

There are many transmissible lethal factors in both plants and animals that stop development at an early stage of embryonic growth when homozygous. In plants there are the numerous defective and germinating seeds that appear when naturally cross-fertilized species are self-fertilized. In some cases growth is stopped immediately after fertilization. In other cases the embryo and endosperm develop in a mass of abnormal tissue that finally breaks down and the resulting abnormal seeds fail to germinate. In many cases the embryos fail to go into their normal resting condition in mature seeds but keep on growing until they finally die with the maturity of the plant upon which they are borne. In animals there are lethal factors that result in the death of the embryo at various stages of development. In some cases the abnormal embryos survive birth resulting in monstrous forms. Not all these are due to single or multiple inherited genes, but many cases have been proved.

An individual heterozygous for these recessive genes may be normal throughout its entire life. But if anything should happen to the chromosome carrying the dominant allele, whereby the protecting gene is lost, abnormal development would be expected under certain conditions. If the change takes place in a critical place the death of the organism might result before the unregulated growth could attain a visible form. In many places unregulated growth would be held in check by surrounding tissues. But there are undoubtedly many places where there are actively dividing cells, and abnormal development starting from them could reach considerable proportions before serious injury resulted. An important point that seems to have gone unnoticed is that genes acting in restricted localities in somatic tissue may have an entirely unrecognized effect as compared to their action in embryos.

In plants unregulated growth can start only in the cambium and in growing points. In the first case the result would be gall formations and in the second, abnormal roots, stems, leaves or flowers which we see in fasciations. In animals similar growths could occur at many places where there are dividing cells. Particularly likely places would be in glands and in regenerating tissues resulting from injury.

Recent cytogenetic investigations have shown various ways in which recessive genes are allowed to appear in somatic tissue due to deletions, non-disjunction and other chromosomal aberrations. Any irregularity whereby a whole or part of one member of a chromosome pair is lost allows the latent genes in the corresponding chromosome to appear, provided there is enough subsequent growth from the deficient cell to become visible. Variable patches of colored aleurone in maize due to deficiency have been noted with a frequency of one in 30 seeds in some families and none in others. These frequencies fluctuate widely. Color variations in vegetatively propagated fruits and flowers are brought about in the same way. In many different animals mosaics of this type have been noted. These variations may be classed as somatic segregations due to *hemizygous* genes, that is, loci of which the corresponding section in the other member or members of the chromosome set is missing. In this way recessive genes become visible.

It is known also that missing segments may have a visible expression in modified characters as a direct result. Thus Notch wing in Drosophila results from a deficiency in the facet region. In this case the variation is not due indirectly to the uncovery of a recessive gene but directly to a loss of chromatin. Since somatic segregation occurs with a high frequency due to the uncovery of recessive genes resulting from a deletion in one chromosome there is the probability of a deletion in corresponding sections of two homologous chromosomes as a chance occurrence. This results in genes that are completely missing. A similar situation follows a viable deficiency in one chromosome and non-disjunction in the homologous chromosome, as shown by Demerec and by Ephrussi.[1] There is therefore the possibility that missing genes due to corresponding deficiencies in certain parts of both members of a chromosome pair result in a chromosomal unbalance and this brings about unregulated growth. Atypical growth in maize has been found associated with chromosome irregularities.

A most significant fact is found in the action of tar and aniline dyes. It has long been known that these substances induce abnormal development in animals in some cases and not in others. It has recently been found that the active principle of crude tar is dibenzanthracene. One of the noticeable effects of this substance when injected into living tissue is to bring about non-disjunction of chromosomes. Many other cancer-producing substances have a similar effect on chromosomes as well as x-rays and radium. If this induced chromosome aberration acts indirectly through the manifestation of hemizygous recessive genes or the total loss of genes necessary for normal growth or directly as a result of chromosome unbalance in particular regions we can understand why unregulated growths occur sporadically but with higher frequencies in some families than in others.

DONALD F. JONES

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

[1] *Proc. Nat. Academy of Sciences*, 1934.

MOTTLED ENAMEL OF DECIDUOUS TEETH

MOTTLED enamel,[1] which we now know to be caused by the poisonous action of fluorine which is present in the water supply of the afflicted persons in the concentration of 1 part per million or above, has been considered primarily a defect of the second or permanent set of teeth. In 1916 McKay[2] said, "Mottled enamel in my experience has never been found upon the temporary teeth." Later, in 1932,[3] McKay modified this statement somewhat to say that "the temporary teeth have been found to be affected very rarely and then only the molars and *very slightly.*"

The writers have personally examined the teeth of thousands of children in Arizona to determine the incidence of mottled enamel and in 1931[1] stated that "deciduous teeth more rarely show mottling, mottling being chiefly a defect of the permanent teeth, although a few cases on the temporary molars of Indian children have been observed." The explanation given for the almost complete absence of mottled enamel on temporary teeth was that in all probability fluorine in sufficient concentration did not pass through the maternal placenta, and hence the deciduous teeth, which were formed and largely calcified before birth, were spared.

It is the purpose of this note to report the occurrence of severe mottled enamel upon all the deciduous teeth of children in a community recently visited by the authors. The first cases noted were those of two sisters, aged 5 and 7, respectively. The condition of the temporary teeth was too severe to be considered typical of mottled enamel. The teeth did not show chalky white areas characteristic of mottled enamel, because most of the enamel was gone. The premolars were ground off almost down to the gum line. The parents of these girls had repeatedly sought dental advice, but the condition had completely baffled the dental profession. A Wassermann test had shown the absence of venereal infection. Analysis of the private well water supply of this family showed a fluorine content of 12.0 parts per million, as determined by the Foster method of analysis, by means of which 1 part per million has been established as toxic level.[4]

Subsequently, other cases of the same severe type of mottled enamel on the temporary teeth have been observed in the same general district. In each case, analysis of the water supply has revealed an extremely high fluorine content (from 12 to 16 parts per million). The fluorine concentration of the water in this district is higher than any reported heretofore.

In spite of the fact that deciduous teeth are largely calcified before birth and have a relatively short period of both prenatal and postnatal development, it would appear that use of water containing excessively high concentrations of fluorine during the period of their formation produces mottled enamel of an extremely severe type on the temporary teeth.

It is interesting to note also that mottled enamel of the permanent teeth has been observed in persons who had not used this high-fluorine-water for drinking, but had used it for cooking and other household purposes only.

MARGARET CAMMACK SMITH
H. V. SMITH
UNIVERSITY OF ARIZONA
AUGUST, 1934.

[1] M. C. Smith, E. M. Lantz and H. V. Smith, University of Arizona Technical Bulletin, No. 32, 1931.

[2] F. S. McKay and E. V. Black, *Dental Cosmos*, 58: 132, 1916.

[3] F. S. McKay, *Jour. Am. Dent. Assoc.*, 19: 15, 1932.

[4] H. V. Smith. Unpublished data. University of Arizona. *Jour. Ind. and Eng. Chem., Anal. Ed.*, 1935.

THE DISINHIBITION OF EXPERIMENTAL EXTINCTION IN THE WHITE RAT

THE phenomenon of the disinhibition of experimental extinction, described by Pavlov for the salivary reflex, is an important characteristic of behavior because it throws light on the conditions which control behavior. The terms inhibition (as exemplified in experimental extinction) and disinhibition refer primarily to the respective non-appearance and appearance of behavior under certain well-defined conditions. Just what the physiological processes concerned may be is still undetermined. It may well be that the phenomena described by Pavlov are quite different physiologically from the other inhibitory phenomena studied by physiologists. Leaving this question aside, however, it is still important to verify Pavlov's findings with the salivary reflex by experiments on such a laboratory animal as the white rat using overt bodily activity of the locomotor type.

The present note reports two experiments. In the first experiment, 4 normal untrained white rats of about 3 months of age were conditioned to a light. This response was then extinguished by withholding reinforcement; after which a buzzer was sounded at medium intensity at the moment when the light should have been presented. When the light was used one minute later, disinhibition was assumed if the rat now responded to the light. The second experiment was conducted with three other normal untrained white rats. In this case the rats were first conditioned to the sound of the buzzer; the response was then extinguished; and the effect of the light as a disinhibiting stimulus was then tested. The buzzer and the light were the same in the two experiments.

The apparatus used was developed in the Clark Laboratory some two years ago as a modification of

one described by Warner.[1] An essentially similar device has been independently developed and reported by Culler, Finch and Girden.[2] In the present apparatus the rat stands on a grill through which an induction current can be sent. In response to the shock, the rat runs in one direction or another along a narrow pathway. The buzzer used in the conditioning was placed over the center of the apparatus. The light used was furnished by two 100 watt bulbs so hung that the apparatus pathway in which the rat ran was essentially uniformly and brilliantly lighted. Throughout the work there was constantly present a low diffused illumination from a small light placed beneath the milk glass plate on which the apparatus stood. The entire apparatus was placed in a relatively soundproof double box through whose window the rat's behavior was observed. It was arbitrarily decided that the rat's response must equal a run of at least a body length before a response was to be counted. This all-or-none standard, although arbitrary, was based on experience and in actual practise proved satisfactory. A synchronous motor timer made possible the automatic presentation of the buzzer and shock stimuli. The buzzer sounded at one minute intervals. Two seconds after the buzzer, a shock was given the rat if no adequate response to the buzzer had been made. No shock was given if an adequate response was made within 2 seconds to the buzzer. Where the light was used either as a conditioning or as a disinhibiting stimulus, its presentation was timed by the clock, but its switch was manually operated. Otherwise the conditions were the same as they were where the buzzer was used.

The 4 rats who were initially conditioned to the light stimulus required 10, 10, 23 and 27 minutes, respectively, for this conditioning before they reached the stage where they would respond 10 times in succession. They required 72, 43, 66 and 74 minutes, during which the light was presented once a minute without reinforcement, before experimental extinction was established to the point where no response was made for 10 successive presentations of the light. At this point, in place of flashing the light, the buzzer was sounded once. No response was made to the buzzer; but when, one minute later, flashing of the light was again resumed at one-minute intervals without reinforcement, one rat responded 3 times to successive lights, one rat did not respond until the third flash, whereupon 6 successive responses were made, one rat responded on the third and fourth presentations of the light, and one rat failed to respond to the first three presentations. When the new (disinhibited) responses to the light were again extinguished to the point where the rats made no response for 5 successive presentations of the light, the buzzer was again sounded once. All four rats then immediately responded to the light for 2 or 3 presentations before extinction again appeared. The above tests were made at one experimental session per rat. Twenty-four hours later in 3 cases and 72 hours later in one case, the rats were again conditioned to the light, if necessary, to the point where they made 10 successive responses to the light; the response was again extinguished to 10 successive failures to respond; and the buzzer was used for disinhibition. Positive results of the above type were secured for all animals.

The 3 rats who were initially conditioned to run to the sound of the buzzer required 29, 17 and 10 minutes, respectively, before they responded 10 times in succession. They required 66, 58 and 54 minutes for experimental extinction of the response, during which time the buzzer sounded regularly at one-minute intervals, the standard of extinction being 10 successive failures to respond. Three, 9 and 10 days later, respectively, the rats were again conditioned to the buzzer, and again the response was extinguished. In the two series of tests, the light was used 9 times as a disinhibiting agent, used precisely as the sound had been used in the first experiment. In 6 of the 9 cases, the light clearly disinhibited the experimental extinction of the conditioned buzzer response, giving the same type of results as were described above where the buzzer disinhibited the extinguished light response. In the other 3 cases no evidence of disinhibition was present.

Walter S. Hunter

Clark University

[1] L. H. Warner, *Jour. Genet. Psychol.*, 41: 57–90, 1932.

[2] E. Culler, G. Finch and E. Girden, Science, 79: 525–1934.

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SCIENCE

VOL. 81 FRIDAY, JANUARY 25, 1935 No. 2091

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

TRAINING, PRACTICE AND MENTAL LONGEVITY[1]

By Professor WALTER R. MILES

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"EVERY body knows," wrote Cohausen in 1742, "how grateful and refreshing we discern the breath of cows to be, which is thence supposed, exceedingly wholesome; . . . There seems, therefore, to be nothing forced or absurd, in conceiving that the warm, active, and balsamic particles thrown off by the lungs of young people into the air, which they respire, may give it such a quality, as when sucked in again by a person in years, shall communicate an extraordinary force to the circulating humors in his body, and so quicken and enliven them, as to bestow a kind of reflective youthfulness, which may for many years keep off and delay those infirmities, to which people of the same age are generally subject. The more we consider this doctrine . . . the more we shall be satisfied of the truth of this conjecture, and the more credible this invention of Hermippus will appear."[2] The indulgent smiles called forth by this hot-air paragraph of hope from a former generation give pause to anyone who undertakes a discourse on any phase of the subject of longevity. The perennial search for the *elixir vitae* stands as one of the seven extravagancies of the mind of man, and he who openly shows himself to be a prospector here or near here may expect to hear voices in concert quoting, "What fools these mortals be!"

Having answered to the description and having attended to these introductory formalities of the occasion may I then proceed to tell you what I intend to say. This paper will deal with normal longevity from a psychological viewpoint. It will not concern cen-

[1] Address of the retiring vice-president and chairman of the section on psychology, American Association for the Advancement of Science, Pittsburgh, December 28, 1934.

[2] J. H. Cohausen, "Hermippus Redivivus: Or the Sage's Triumph Over Old Age and the Grave." Tr. into English by J. Campbell. Edited by E. Goldsmid. In three volumes. Privately printed, Edinburgh, 1885, Vol. 1, pp. 20 and 27.

tenarians, nonagenarians, or even octogenarians. There will be no attempted consideration of the factors of race, heredity, climate, food, drink, rural *versus* urban surroundings, marital state, or medical care. These stock topics concerning a man's family, place and physical way of living constitute the subject-matter for the often trite inquirer, which, throughout countless generations, have been made about nearly every human who has happened to be an example of extended or abnormal longevity. I shall try rather to interrogate the ways of the mind than those of the body, inseparable though mind and body appear to be. The type and regimen of inner experience that perchance is positively correlated with preferred mental-life risk or prospect is what I desire to glimpse. The ancient query, "Can a man by taking thought add one cubit to his stature?" implied a prompt unreserved "no" as answer. But the familiar phrase, training accentuates psychological traits and practise makes perfect, we readily accept as applicable to the baby, the child and the adolescent. The young or moderately young by taking thought, we believe, can lengthen the attention span and the memory reach, increase the vocabulary, multiply discriminable differences, develop problem-solving techniques, accelerate directness in creative work, and in scores of other ways modify the mind and its complicated mechanisms of expression. What comes of such self-organization and regimentation when we reach older years? Is there any evidence to support the theory that our mental longevity will be appreciably influenced by the climb in psychological skills which we make early or moderately early in life and by the use-disuse ratio which we permit between our earlier and later decades? A modern court has ruled that, "less mental faculty is required to execute a will than to enter into any other legal instrument."[3] Can man through the mental gymnastics and by the continuance of psychological wakefulness associated with professional or avocational activities insure himself with nature for something in late life better than mere disposing memory or testamentary capacity, important though that may be to a few interested persons? This general question I should like to help to answer.

The Old-Age Test

The attainment to old age is the most ancient and honorable physical-mental test performance known to the experience of man. As a test it is presumed to have a very respectable degree of reliability and irreproachable validity. The test is given under natural rather than artificial environmental surroundings and the population concerned is adequate. The results appear to be trustworthy and permissible of broad generalizations; they are accepted by the majority, although being at the same time sharply criticized by smaller groups. The items which compose the test are mostly stock items which were selected long ago after a great deal of preliminary trying out of this material and that. There are slight variations of emphasis within the test from generation to generation but the general get-up and form of the examination appears to have remained much the same during the past few centuries in spite of the apparent danger from coaching. In fact coaching rather than being prohibited has come to be looked upon with socio-scientific favor.

Considering our problem in closer detail it is of course obvious that on the quantitative side we must not confuse old age with the year value for expectation of life at birth. The great change in life expectation as an average mortality value has been wrought in our statistics through the triumphs of medicine and public health in dealing successfully with problems of infant and child life risk. Richardson's[4] recent study of inscriptions on 2,022 Greek sepulchers shows an average age at death of 29.4 years. Probably, due to burial customs, this value is somewhat higher than Hippocrates and Galen would have given us had they been interested in a statistical approach to these matters. Results compiled in Geneva for the 16th, 17th and 18th centuries respectively show, 21, 26 and 34 years as mortality averages. In Massachusetts just before 1800 the value was 35 years and by 1890 we find 43 years. In 1900 for the U. S. registration states it was 49 with an increase to 51 for 1910, and averaged 56.4 for 1920. Now 15 years later we appear to stand at 59.3 years for males and 62.8 for females. One does not have to be either a biometrician or an actuary to understand readily that any ascertained gain in average life expectancy is meaningful chiefly by interpretation in reference to life expectancy found in different portions of the theoretical human life-span. It is now generally agreed that practically all of the widely heralded change has occurred in the decades below 50. Those who reach the half-century mark to-day have practically the same chances of life and death as had their parents, grandparents, and perhaps their earlier ancestors. For example the expectation of life at age 52[5] throughout our country holds almost as close to 21 years as does the percentage value for the oxygen content of outdoor air. It is a little less than 21 years for men of 52 and a little more for women of this age. The sex difference amounts to nearly a full year and appears to be statistically reliable. The progress

[3] [illegible] Sur. 1921. In re Tymeson's Will 187, N. Y. S. 330; [illegible] Misc. Rep. 643.

[4] B. E. Richardson, "Old Age Among the Ancient Greeks," Baltimore, Johns Hopkins Press, 1933, p. 376.

[5] R. H. Lyman, Ed. "The World Almanac and Book of Facts." New York, World-Telegram, 1934, p. 292.

difference measured in less than half-century steps is small and doubtful, possibly about three tenths of a year since 1900, and this gain some have credited to the hospital accessibility enjoyed by large urban groups. Progress in scientific medicine and hygiene presumably must influence the tenability of the older decades of the human life-span and we seem to be justified in believing there has been some progressive upward shift even though old literature said three score years and ten with sometimes four score, and to-day this same formulation fits the facts. Perhaps it is not inappropriate to compare the Greek data[4] with the U. S. 1930 mortality tables. If we take the Greek cases recorded as dying at age 50 and older, a total of 332, the successive decades from the 6th to the 11th respectively show the following percentages: 38.0, 28.0, 19.3, 10.5, 3.3, and 0.9. The comparable percentage values for the United States in 1930 of persons 50 years and older are found to be: 23.0, 29.2, 29.8, 15.5, 2.3, and 0.2. The two series of values resemble one another. But the high point of death incidence in the Greek group falls in the 50's while for the recent Americans it is found between 60 and 79. The shift seems large enough to talk about, but it is not the time now to deal with this specific point in detail. The favorable shift that has occurred does not contradict the essential conditions leading to our conclusion that the long-life test continues in one generation after another to show a relatively unchanged mean score norm available in measurement and comparison and against which an x number of factors can be viewed.

LONGEVITY AS A MENTAL TEST

As psychologists the factors that occur to us as particularly interesting for study in reference to old age are those having to do with the intellect in its aspects of endowment, performance ability and with training and experience. Traditionally wisdom has been associated with age and various features of primitive as well as civilized culture patterns have contributed to confer distinction and leadership on the old. Genius and eminence rank high in actuarial folklore and perhaps if we could get at the basic facts they would still bear out the resultant popular belief. The life-spans of 115 eminent ancient Greeks classified according to primary fields of achievement show averages that surpass what seemingly was for the bulk of their countrymen usual. I will mention four professional groups for each of which the number of cases is not too trivial: 38 philosophers lived on the average to 78.8 years, 26 writers (poets) 79.3 years, 25 writers (historians, critics) 78.4 years, and 10 orators, 71.6 years. The average was 77 years and 45 per cent. of the group reached the 80-year mark. An earlier piece of work than the study of Richardson on the Greeks was that by Cox[6] on the 282 most eminent men born between 1450 and 1850. In that investigation it was found that 42 lived 80 years or longer, whereas within an average group of this size only 3 or 4 might be expected to reach that age. The 22 philosophers slightly surpassed 68 life years, 43 poets, novelists and dramatists and 23 religious leaders averaged just under 68 years; 52 historians, essayists and critics did not quite reach a mean life span of 64 years, while the group of revolutionary statesmen got off with about 51. The total average for the 282 geniuses was 65.8 years. Undoubtedly it is a fair question to ask how far long life pushes a man toward eminence. Given 100 men of equal ability the 50 who live longest should of course achieve greater average distinction. It seems very clear, however, in this comprehensive study of the 282 distinguished persons that mental accomplishments in early and mature years and not chronological longevity constitute the social criteria of greatness. Hence the correlation between age and achievement is the more meaningful. Outstanding mental grasp and strength makes its professional business that of working with and creating values from physical, biological and cultural materials but as a rule such strength does not neglect incidentally to pass the old age test with an appropriately high score.

Human century plants breed from capable common stock and themselves tend to be above average in capability. Primitive environment and lack of education may have handicapped them in many instances, but it is not unreasonable to believe that mental alertness has survival value and will be found to correlate positively with those somatic and functional traits of skeleton, heart, endocrines, nervous system and so on which make for "long lasting." I am not acquainted with any more significant data on this phase of our topic than those published fifty years ago by Humphry[7] who with the aid of many interested British physicians secured information concerning nearly nine hundred persons who had attained the age of eighty years, including seventy-four centenarians. Intellect and memory constituted two of the several topics studied in these populations selected only for age. Discussing the then "present condition" of a group of fifty-two centenarians the statement made was: Intellect—forty-six returns, high 11, average 29, low 5, childish for 6 years 1. One was said to be slow in comprehending questions, but smart in reply. Memory: (a) recent events, thirty-nine re-

[6] C. M. Cox, "The Early Mental Traits of Three Hundred Geniuses." Vol. II, Genetic Studies of Genius, Stanford University Press, Stanford Univ., Calif., 1926, pp. 35-36.

[7] G. M. Humphry, "Old Age." Cambridge, MacMillan and Bowes, 1889, pp. 218.

turns; good 26, moderate 7, bad 6; (b) past events—forty-seven returns; good 39; moderate 4, bad 4. "One remembers and will quote a great deal of the Bible, another could repeat about 100 Psalms correctly." The temptation to give more of Humphry's results is great. What I have included are typical and I think significant. High ratings of intelligence exceed low ratings in the ratio two to one or better. We know from the rather recent experimental work on the course of the intelligence score curve in adulthood[8] that the correlation between age and score from the age of 20 to 95 years in homogeneous population is usually about −.40 in speed tests and −.30 where speed is not involved. The difference between the average scores in the twenty-year group and in the eighty-year group in a timed test is near 10 times the sigma of the difference. The drop between age 18 and age 85 is possibly 60 per cent. of the peak score amounting to fully 5 mental age years. When an old person is judged to be of average adult intelligence, unless we must allow for a very large chance error in the judgment, it is a fair assumption that his or her intelligence in early adulthood would have rated considerably above average. If we take this into account in reference to Humphry's findings for intellect in advanced age the significance of the findings appears to be increased and they are seen to conform the more strikingly with the long life trend found among men of eminence and genius.

THE INTELLIGENCE-EXPERIENCE PARTNERSHIP

I have spoken of the correlation between human superiority and longevity in undoubtedly too simplified a formulation and the statements at this stage represent more a point of view than a fully demonstrated scientific finding. The nature-nurture knot is no less tight and stiff here than elsewhere. Professional groups, including, for example, judges, clergymen, and physicians show remarkably prolonged active careers and in insurance circles are termed preferred risks. The word "professional" implies training and practise of a high order as dominant features which characterize a type of life or of human being. From a multitude of psychological and educational studies we are convinced that those who present themselves as candidates for and who successfully carry through prolonged intensive professional training are at least of high average and more usually of superior intelligence. Mental endowment plus training constitute the effective partnership which through practice functions with such outstanding efficiency in the professional groups in comparison with the general population averages. We do not wish to dissolve this partnership, that would be perilous. We are curious to know who is who among the active directors and if practise is more than a well-trained shipping clerk. Anecdotal-descriptive treatments of what might now be called the ability-practise-age problem have been many particularly if we turn to the biographical and autobiographical literature. On the other hand, scientific psychology has been slow to follow the lead of Galton in attempting laboratory measurements with adult age as the chief variable. Only within the last decade have such studies begun to appear in our experimental literature and there are scarcely more than a dozen of them to date. It has been a real triumph to win the cooperation of men and women in all decades of life and I feel that my own research, the Stanford Later Maturity Study,[9] is distinguished by reason of the cooperation of older adults. More than 300 people 70 years of age or older have come to our testing laboratories to be tested and studied. There is a thrill in the realization that a new and important human territory is opening for scientific exploration and therefore to some extent we may believe, for better scientific control. So far the psychological experiments conducted on the influence of adult age have been attempts to measure the ratio between scoring ability and age along various strategic psychological arteries. Attention has been centered on the measurement and the correlations rather than on the populations. The experiments could not be set up specifically to emphasize the relative influences of native ability and of experience until the normative data were gathered. However, even in the exploratory stage there appear some experimental results which may be examined from this angle of interest as indicators of probable trends and of points of attack for further investigation.

MOTILITY AND MOTOR FUNCTIONS

Physiological age exacts its tax year by year as the individual grows older; but psychological age adds to the personal capital stock of experience and bonds of association as real assets to be drawn upon. The presence of so-called senile tremor in its early unexaggerated stages is no doubt an annoying inconvenience. But as may be commonly observed there is a conspicuous lack of disability in consequence of it. Fine manipulations of the fingers as in sewing, writing or the use of instruments, even those of precision, are continued with great skill by many who have quite observable tremor. Even though loss of quickness and

[8] C. C. Miles and W. R. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity." *Amer. Jour. Psychol.*, 44: 44–78, 1932; C. C. Miles, "Influence of Speed and Age on Intelligence Scores of Adults." *Jour. Gen. Psychol.*, 10: 208–210, 1934.

[9] W. R. Miles, "Age and Human Ability." *Psychol. Rev.*, 40: 99–123, 1933. These studies have been supported by the Carnegie Corporation of New York.

accuracy in leg coordinations may serve to retire a 40-year old baseball player from the big leagues it is none the less true that in many of the motor functions the decline from a peak which may have occurred in the 20's or 30's is slow and apparently considerably retarded through the effect of occupational or other practise engaged in by the mature individual.

The influence of training and practise, the psychological assets, upon the physiological motor functions, is well illustrated with respect to a complicated skill in performance in the sport of trap-shooting, where not a few of the nationally famous expert champions are men considerably beyond middle life. Recently I have examined some data for 400 trap-shooters including their scores at a national tournament in 1932 gathered by Mr. Edward Pugsley, of the Winchester Repeating Arms Company. The scores measure visual reaction time by use of an electric circuit with a flashlight target, a chronograph and a gun. The ratings used are based on the first four reaction shots. A group of 28 trap-shooters in Class AA with an average age of 44.5 years averaged 191 sigma while 43 Class A men averaging two years younger, that is 42.3 years, gave the less good report of 198 sigma. Of more significance for our present problem than distinguishing between AA and A classes of trap-shooters is the matter of the regular relation of age to performance skill and here, in general, decrement does occur. One hundred and seventeen men whose ages were known to be between 20 and 49 inclusive gave an average reaction time of 200 sigma as compared to the average of 209 sigma for 58 men aged 50 to 85 years. All of the mean values are just a little higher for the older group, the reaction times averaging about 4.5 per cent. longer. For 33 trap-shooters aged 40 to 44, the average is 203, and for 26 aged 50–54 it is 206. But in the very young group the trend is reversed: 13 young trap-shooters from 10 to 19 years of age competing in this national tournament average 246. The extraordinary contribution of the trap-shooting test is in the example it provides of the counterbalancing effect of the psychological elements of skill, practise and experience upon the inevitable physiological ravages of age. Neither Galton's data gathered in 1884 and recently analyzed and published by Ruger[10] nor my own in the Stanford Maturity Research nor that of any of my associates duplicate this particular good example of the weight of experience counterbalancing the weight of years with respect to a motor skill. I believe that similar examples will be found in the realm of the skilled trades and occupations where men with zest and interest really exert themselves on materials and in tasks with which they are familiar. Trap-shooting is unique only in being highly standardized and scorable. Results from laboratory measures of motor functions elaborate and substantiate the interesting trap-shooting findings. Series of tests of speed of movement where the mental organization element is slight show the age decrement as fairly large; when the test includes the elements of selection and adjustment of the movement or movements with respect even to some fairly familiar or easy task, experience reduces the decrement. For example, in the simplest movement of the index finger of the preferred or dominant hand, that is, lifting the finger off a key and pressing it down again, shows a marked decrement with age. The much more complicated task of opening three ordinary letter size envelopes with a paper knife on the other hand shows less change with age. The correlation coefficients for these two contrasted functions for large groups of persons 20 to 90 years of age are $-.57$ for simple speed of movement, $-.46$ where a planful use of experience is even so slightly involved as in the task of letter opening. Well-practised complicated skills and especially those which do not tax strength too severely show the best degree of retention among the motor functions and here with thoughtful planning a great contribution to mental longevity may be made.

[10] H. A. Ruger and B. Stoessiger, "On the Growth Curves of Certain Characters in Man (Males)." *Ann. Eugen.*, 1927, 2, Pts. I and II, 76–110.

SENSORY AND PERCEPTUAL FUNCTIONS

An old English proverb says that no agricultural laborer who is more than forty years old can hear a bat squeak. I am not aware that Galton made any calibrations on bats but with his famous whistle he did verify the effects of the auditory decrement with age. From his data as published by Ruger on 3,816 men, ages 25 to 81, a recently calculated correlation coefficient for age with highest audible pitch gives $r = -.482 \pm .008$. That our eyes tend to grow old rather early has been more generally remarked than has the downward course of the hearing function. Decreases in accommodation power and in visual acuity are among the first harbingers of age to which we give heed. Here Galton's adults, 3,850 men, ages 25 to 81, show a negative correlation of age with visual acuity, $r = -.512 \pm .008$. The results which more recent investigators have gathered in their laboratories closely agree with the trends indicated by these coefficients and show that we are, so to speak, up against an inexorable law of decline with respect to the simple physiological sensory functions. Fortunately ophthalmology and autology have come to our aid and we may expect the development of further mechanical techniques to supplement practically the slight preventive and remedial measures that may be applicable to sensory age-decrement. A tomb in

Florence bears an inscription which reads: "Here lies Salvino degli Armati, Inventor of Spectacles. May God pardon his sins." Although this sentiment is a little ambiguous I take it to indicate human gratitude to one who helped us in the more effective use of these functions in which we are little able to help ourselves.

When the sensory functions are employed in tasks more complicated than mere acuity tests, with opportunities for interpretation of content and meaning, the psychological factor enters and the results are less unfavorable for age. That is, the situation here is parallel to that mentioned in the field of simple motility as compared with more complex motor functions. In a tachistoscopic study of perceptual ability where letters, digits, words, sentences, colors and simple diagrams were employed as content by which to measure the amount grasped in a single visual exposure it was found that the correlation of perceptual score with age was −.43 which is considerably lower than the decrement coefficient for visual acuity and age. Then when the same subjects were tested for speed of reading a standard passage the coefficient became still smaller, reaching a value of −.27. From these and other similar results it seems that familiarity or naturalness in the test situation together with a degree of complexity which gives scope for individualized mental technique operates for an increase in scoring power in mature and older adults.

Perception in the old as compared with the young, although not as prompt or as great in span, is frequently joined with the quality of perseverance or persistence in consecutive efforts. This results in relative evenness of performance, a point for which old age should and often does receive due credit in industry. It appears to be a modification referable to practice and through it a broadening of perceptual interest can be achieved.

Learning and Memory

Blurred memory like blurred vision is frightfully conspicuous to him who has it. And as to the relation between memory and mental longevity doubtless many hold with Longfellow,

> "Whatever poet, orator, or sage
> May say of it, old age is still old age."[11]

But actually the annoyance and frustration caused by slight forgetting may be subjectively quite exaggerated and out of proportion to the actual amount of defect. Furthermore we may observe that it is a popular and wide-spread conversational habit among middle-aged people and even some adolescents as well as among the old to make disparaging remarks concerning their own memories. These faithful and hard-worked functions are talked about with the same unsympathetic objectivity and blatant candor that was once used in discussing cooks or maid servants. For a kinder and probably truer picture we may look again with profit to Humphry's data.[12] In his analysis of the returns relating to 340 males and 282 females 80 to 90 years of age we find that memory for past events is reported good in 82 per cent. of the men and 73 per cent. of the women, moderate in 11 per cent. of the men and 16 per cent. of the women, and bad in only 7 per cent. of the men and 12 per cent. of the women. Memory for recent events is reported as follows: good, men 64 per cent., women 54 per cent.; moderate, men 21 per cent., women 26 per cent.; bad, men 15 per cent., women 19 per cent. No comment need be made on what I am content to believe may be an unreliable sex difference here except to suggest that the matter of occupational necessity may bring practise more favorable to the men. My point is that memory function is not universally bad or even moderately bad among older people. To be sure, on the average, memory shows some decrement with age as we have measured it in successive decade groups of different individuals, but the memory decrement is not larger than that usually found for other mental functions. A straightforward memory task involving familiar material or concepts may be counted on to yield a negative correlation with adult age of about .40. However, if the material consists of nonsense syllables or involves mastering relations that are contrary to established mental associations the coefficient is more likely to be approximately −.60. Ruch[13] in one of the Stanford Later Maturity Studies has dealt especially with this matter of practise and memory as it relates to the use of previously familiar material. His results agree with those of Willoughby, Jones, Conrad, and Horn, and with Thorndike, Bregman, Tilton and Woodyard[14] in finding that the meaningful previously acquired content items could be learned with much less age deficit than was found for extensively reorganized or nonsense material where long-established mental association habits operated as interference to learning. When, in studies of adult learning, we classify the men and women in terms of the amount of formal schooling in three groups: college, high school and grade school, the three resulting sets of results fall in line with what we may suppose correspond to three grades of

[11] H. W. Longfellow, "Morituri Salutamus."

[12] *Ibid.*, G. M. Humphry.

[13] F. L. Ruch, "The Differentiative Effects of Age upon Human Learning." *Jour. Gen. Psychol.*, 11: 261–286, 1934.

[14] All summarized in W. R. Miles, "Age and Human Society." Ch. 15, C. Murchison (Ed.), Handbook of Social Psychology, Clark University Press, Worcester, Mass. In press.

training for practise. For example Price[15] with a reliable directions test, making use of immediate memory, found a correlation coefficient of −.51 and a regular point score decline per decade of 6.7 in the college population, 7.1 for the high school population and 9.6 for adults with grade school education. The greater decrement at the lower educational level must be in part a function or a correlate of less general ability, but the influence implied in experience is also demonstrated by individual differences within the three groups.

INTELLIGENCE AND AGE

The direct and positive relationship between human intelligence and chronological age during childhood and youth has probably always been obvious to man and was not difficult to demonstrate scientifically after appropriate tools had been developed for working with mental performance ability. In contrast adult minds have typically been thought of as continuing relatively unchanged except in accumulation of experience for several decades just as the skeleton of the adult having completed its growth was thought to undergo only slight modifications until the active processes of senile change set in late in life. Relatively few have had the insight and the temerity demonstrated by Montaigne when he said, "For my part, I believe our souls are adult at 20 as much as they are ever like to be, and as capable then as ever. . . ." Here he inserts a quotation, "if the thorn pricks not when it first shoots, it hardly ever will at all," and then continues. . . . "Of all the great human actions I ever heard or read of, of what sort soever, I have observed, both in former ages and our own, more performed before thirty than after; and oft times in the lives of the same man. . . . As to myself, I am certain that since that age both my understanding and my constitution have rather decayed than improved, retired rather than advanced. 'Tis possible that, with those who make the best use of their time, knowledge, and experience may grow up and increase with their years; but vivacity, quickness, steadiness, and other qualities, more our own, of much greater importance, and much more essential, languish and decay."[16] This mental dissection by Montaigne cuts rather too close to the quick for comfort and rather hastily discards much that might be called supporting mental structure. However, even though as individuals we may be loathe to admit it, since self-evident decline is not usual, still our practical experience does show that many perhaps most of the easily measurable human capacities decline with respect to the compound quantity-quality output after we pass middle age and before we have reached old age. Serious scientific work in this field has only recently begun and the preliminary data so far published comparing the various psychological abilities throughout the life span are almost entirely based upon measurements of different individuals within the decades and semi-decades where comparison is made. Quite regularly it has been found that the maximal scoring ability occurs between the ages of 18 and 49 whether the test be of general intelligence or of a more restricted aspect of mental activity. Performance tasks which strongly emphasize the factor of speed somewhat penalize the old but tests given with unlimited time seldom fail to show some progressive decrement throughout the last four or five decades of life. The correlation coefficients found between scoring ability and age for the range from 25 to 95 years extend from small plus or nearly 0 values to minus .65 with the usual correlational value falling near −.3. Not all measurements thus far taken show a clearly continuous decline from the late 20's to the early 90's. For some there is a fair plateau until perhaps the late 40's or early 50's. For others there is scarcely any change even in advanced age.

We may survey briefly some of the experimental results for adult age which have been found in this broad field of judgment and reasoning which we call intelligence. Let us examine first some of Galton's measurements.[10] He had in all seventeen, which included three judgment tests: (1) sense of perpendicularity, error measured in degrees; (2) error of bisection; and (3) error of trisection, in both of which the score was in percentage of the length, bisected or trisected. The published data include about 3,815 cases with age range between 25 and 81 for each of the three. The correlations between age and score turn out most interestingly to be practically zero: perpendicularity $+.058 \pm .011$; bisection $+.071 \pm .011$; and trisection $+.033 \pm .011$. Clearly, with this type of task which closely approximates the activity involved in the fundamental spatial judgments of adult life there is no decrement with increased adult age. And yet these judgments correlate decidedly with intelligence and we know that the feeble-minded or the very young can not make them. Results for similar functions show similar results in the more recent Stanford Study. From these we may turn to a kind of test in which experience varies more profoundly and practical as well as theoretical intelligence is measured. The Stanford battery of 1932 included the McFarland Coat Assembly Test (by snaps a complete garment is to be put together from 9 pieces) and a painted block assembly test (a painted 3 inch cube

[15] B. Price, "A Directions Test Arranged as an Interview and a Determination of Adult Age Effects Therewith." Stanford Univ., Calif., 1933. Unpub. Ph.D. Thesis.

[16] M. de Montaigne, Works, New York, 1872. Vol. I, Of Age," p. 467 ff.

that has been cut into 1 inch cubes has to be reassembled). What happened in the case of the coat test? The men showed the usual decline with increasing age, the women did not. For them the influence of experience was so usefully complete that even though the garment design was novel they succeeded about equally well decade by decade up to the 70's. On a repetition of the task the women made relatively less gain than the men for they were already nearer their physiological limit of speed, and insight due to experience had been present from the first. The men made a great improvement on the second trial; for them the experience and practise of the first trial was unique and therefore highly important. In the block test the situation was not reversed, the women showed a less good performance but also less age decline than the men. Actually, as indicated by the two coefficients: for the women $r = -.330 \pm .03$; for the men $r = -.435 \pm .029$. Putting together a series of blocks isn't mechanical enough to baffle the average woman but a group of men in the 50's and 60's with experience in mechanical fields exceeded other men of the same ages and equal general schooling by a difference that is 2.5 times its standard error.

Coming now directly to what are generally called intelligence tests we find that the scores for the Otis Omnibus Test continue to show in one population after another the same age decline and the same experiential retardation in this decline that appeared in our first study. But when the test is broken up into its elements by functional type into verbal, reasoning and mathematical items and when we sort the responses of four hundred men and women representing all the adult life decades we find a differential scale of decline with age from the least to the most affected of these three general types. Representative samples from several tables of correlations will illustrate the trends. For men and women of the general population (combining those of grade school and high school education) the correlation coefficients of scores with age from 25 to 90 years run as follows: Synonym-Antonym, +.013; Vocabulary, -.043; Analogies, -.105; Logical Selection, -.091; Proverbs, -.164; Arithmetical Problems, -.237; and Number Relations, -.262.

This finding that language functions, examined differentially, are relatively impervious to old age change and represent basic assets for mental longevity has been demonstrated by other investigators also. Clinical medicine has always counted on the language function in its patients. Hollingworth[17] in 1920 pointed out that the old succeed well in tests of completion, opposites and word-building; Thorndike[18] and associates have more recently amassed further data in these matters in their study of learning; and Babcock's[19] use of their present vocabulary in estimating the earlier intelligence of deteriorated patients is a practical application of this finding based on further corroborative data.

At present no definitive answer can be given to the question of how large a rôle is played by training and practise in producing the decline differential between language and reasoning. If reasoning and arithmetic as representatives of types of mental function were practised as continuously as language tends to be they too might show a slim and trim correlational figure. Of course what we actually believe is that in many an individual such practise and such substantial fruits of practice are to be found hence the great amount of individual difference which is present in the period of later maturity.

Old Age a Test of Practise

Brightness and dullness, experience and inexperience, mutually enhance each other in this world of human affairs. He would be stupid indeed who tried to abolish one or the other in any of these pairs. If into a fire-fly is injected a little adrenin he quits being intermittent and remains illuminated all night long. But the treatment is not supposed to be of benefit to the fire-fly. I have not discovered any psychological adrenin to change our human mental intermittency and deficiency into steady powerful light and most of us would quite properly hesitate to be inoculated were the substance at hand. It is neither the elimination of contrast among men nor an unchanging plateau in our own experience that we seek. The final orientation of my thesis to-night will be clearer if I remind you that just fifty years ago our eminent chairman Dr. James McKeen Cattell invented the term "individual differences" and published the first experimental psychological studies devoted to the subject.[20] In this jubilee year of that epochal event in scientific psychology I am glad to affirm my belief in the basic importance of this great principle. My thesis to-night is that training and practise account for a large amount of that considerable gain which is possible to each one of us, from year to year, within the range from less to more that represents

[17] H. L. Hollingworth, "Psychology of Functional Neuroses," New York, Appleton, 1920, pp. 259. See Ch. 12, pp. 187–199, "Mental Ability and Chronological Age in Adults."

[18] E. L. Thorndike, E. O. Bregman, J. W. Tilton and E. Woodyard, "Adult Learning." New York, Macmillan, 1928, pp. 335.

[19] H. Babcock, "An Experiment in the Measurement of Mental Deterioration," *Archives of Psychol.* (New York) 1930, 18: No. 117, pp. 105.

[20] J. McK. Cattell, "The Inertia of the Eye and Brain." *Brain*, 8: 295–312, 1885. See the last paragraph. Note the objective non-introspective character of this early psychological paper.

our own natural minimum or maximum potentiality. It is this modifiable or extensible aspect which, contributing to the individual differences, found among men and women of mature and late age provides the most practically controllable and definitely trustworthy psychological insurance and affords the most probable prospect of mental longevity.

I therefore conclude by quoting the closing sentence in the paper of 1896 by Cattell and Farrand,[21] "There is no scientific problem more important than the study of the development of man, and no practical problem more urgent than the application of our knowledge to guide this development." The study of man in maturity shows that his psychological progress is not bound utterly to the lowest level of his physiological decline. Through appropriate training and practise, continued mental elasticity and organized effective control, may extend mental longevity.

OBITUARY

NATHANIEL LORD BRITTON[1]

THE Board of Managers of The New York Botanical Garden desires to place on record the following minute in regard to the passing of Nathaniel Lord Britton, which occurred on June 25, 1934:

The history of The New York Botanical Garden is inseparably interwoven with the name of Dr. Nathaniel Lord Britton. In originating and developing the idea of a great institution in the City of New York, to be devoted to the study of the plant sciences and to the public display of plants and plant products of scientific, economic and horticultural interest, the time and the place most fortunately met the man who possessed the rare qualities that could guide this ambitious undertaking to distinguished success. Making a definite start with an act of the state legislature in 1891, incorporating The New York Botanical Garden, the project was steadily advanced until in 1895 the $250,000 required under this act for its initial endowment had been raised by subscription, the Commissioners of Public Parks had set aside for the purpose 250 acres of land in Bronx Park (afterwards increased to 400 acres), and the Board of Estimate had appropriated $500,000 for the erection of suitable buildings. During all this period of preliminary organization, Dr. Britton, with able associates, was the motivating spirit. A board of managers had already been elected, with Cornelius Vanderbilt as president, Andrew Carnegie as vice-president, J. Pierpont Morgan as treasurer, and N. L. Britton as secretary. Seth Low, president of Columbia University, accepted the chairmanship of the scientific directors, and an affiliation between Columbia University and the Botanical Garden was arranged. On June 17, 1896, Dr. Britton was elected director-in-chief of the garden, a post that he held with unflagging energy for a little more than thirty-three years. Retaining a connection with Columbia University as professor emeritus, he soon exhibited an altogether remarkable ability in combining the qualities of a technical research worker with those of a practical administrator and a successful author of scientific books. Dr. Britton soon perceived that the West Indies and Central America offered a largely untouched field for exploration by systematic botanists as compared with the northeastern United States. He participated personally in no less than thirty expeditions to the West Indies, mostly at his own expense. The results of Dr. Britton's studies are recorded in very numerous publications, of which some of the principal ones are the "Illustrated Flora of the Northern United States and Canada" (three volumes—with Judge Addison Brown), the "Manual of the Flora of the Northern States and Canada," "North American Trees" (with Dr. J. A. Shafer), the "Flora of Bermuda," "The Bahama Flora" (with Dr. C. F. Millspaugh), "The Cactaceae" (four volumes—with Dr. J. N. Rose), the "Botany of Porto Rico and the Virgin Islands" (two volumes, with Mr. Percy Wilson) and several important contributions to the "North American Flora." Dr. Britton was the leader in organizing and developing the "Scientific Survey of Porto Rico and the Virgin Islands," of which five volumes of the projected eighteen and eighteen parts of other volumes had been published at the time of his death. To this remarkable record of scientific achievement in the way of printed pages must be added the constructive leadership that resulted in a little more than a third of a century in building out of raw materials one of the leading botanical institutions of the world. In grateful recognition of the eminent services of Dr. Britton the Board of Managers adopts the following resolutions:

Resolved, That the Managers of the New York Botanical Garden deeply deplore their loss in the death of Doctor Nathaniel Lord Britton, their Secretary from March 21, 1895, to August 1, 1929, and Director-in-Chief of the Garden from June 17, 1896, to August 1, 1929. Doctor Britton combined to a remarkable degree the social, administrative, and scientific qualities that were

[21] J. McK. Cattell and L. Farrand, "Physical and Mental Measurements of the Students of Columbia University." *Psychol. Rev.*, 3: 618–648, 1896.

[1] Minutes of the Managers of the New York Botanical Garden and of the Council of the New York Academy of Sciences.

requisite for the development of an institution of the kind proposed, and his success in little more than thirty-three years in placing The New York Botanical Garden in the forefront of similar establishments fully justified the wisdom of the choice. It is doubtful if any one else could have been found who would or could have attained similar eminent success in the existing circumstances. The New York Botanical Garden is, in a very real sense, a living monument to Nathaniel Lord Britton. Possibly his printed pages may endure even longer.

Resolved, That the foregoing preamble and resolution be entered on the official minutes of the Board of Managers and that copies thereof be sent to the surviving brother and sister of Doctor Britton, with assurances of profound sympathy in their bereavement.

The Council of the New York Academy of Sciences desires to place on record the following minute in regard to Nathaniel Lord Britton, whose death occurred on June 25, 1934:

Dr. Nathaniel Lord Britton was one of the oldest and most active members of the New York Academy of Sciences, having been elected to membership in 1880, at the early age of 21 years, and becoming fellow in 1884, patron in 1901, president in 1906 and 1907 and benefactor in 1918. In December, 1890, he proposed to the council a plan for the alliance of the numerous special scientific societies that had grown up in New York, and a few months later the Scientific Alliance of New York was fully organized. Sixteen years later the component societies of the alliance were affiliated with the academy. In spite of his absorbing duties for thirty-three years as the first director-in-chief of The New York Botanical Garden and his tireless activities as author of many voluminous works on botanical science, he always maintained a keen interest in the work of the academy and gave freely of his time and means to its support. In December, 1915, he suggested to the council the celebration, in 1917, of the one hundredth anniversary of the founding of the Lyceum of Natural History, the forerunner of the academy. Owing to the involvement of the United States in the world war, the ambitious plan for such a celebration was modified and partly abandoned, but there remained a Centennial Fund for the endowment of the academy, to which fund he was the largest contributor. In 1913, largely under the leadership of Dr. Britton, a proposition for a scientific survey of Porto Rico was approved by the council and a special committee of five, with himself as chairman, was appointed to organize and develop the project. The scope of this survey was later extended to include the Virgin Islands. At the time of his death, five of the contemplated eighteen volumes of the reports of the scientific survey, together with eighteen parts of uncompleted volumes, had appeared. Nothing comparable has ever been published for any other of the West Indian Islands. The cost of the publication of the botanical volumes of these reports was underwritten by Dr. Britton himself. His personal popularity in political and educational circles on the island was in a large measure responsible for generous appropriations by the Government of Porto Rico for defraying the costs of other volumes.

In his last will and testament, Dr. Britton gave final proof of his devotion to the work of the academy by bequeathing to it, without conditions, a one twelfth share in his residuary estate.

In grateful recognition of the loyalty of Dr. Britton to the New York Academy of Sciences, the council adopts the following resolutions:

Resolved, That in the passing of Doctor Nathaniel Lord Britton, the New York Academy of Sciences has lost one of its most eminent members and one whose constructive leadership will be greatly missed, even though his foresight and devotion have assured that his generous support of scientific research and publication will long continue. And

Resolved, That the foregoing preamble and these resolutions be spread upon the minutes of the Council and that copies thereof be sent to the surviving sister and brother, with assurances of the deep sympathy of the Council in their bereavement.

RECENT DEATHS

George Anson Hamilton, of New Jersey, an honorary and charter member of the American Institute of Electrical Engineers and a retired consulting engineer of the Western Electric Company of New York, died on January 10, at the age of ninety-one years.

Edward C. Holton, chief chemist for the Sherwin-Williams Paint Company, died on November 30, at the age of sixty-nine years.

Dr. Robert C. Burdette, associate entomologist for the New Jersey Agricultural Experiment Station at Rutgers University, a member of the station's staff since 1928, died on January 6, at the age of thirty-six years.

Dr. Frederick Augustus Dixey, formerly bursar and lecturer of Wadham College, Oxford, and curator of the Hope entomological collections, died on January 17, at the age of eighty years.

Professor Grandclaude, the assistant director of the Cancer Clinic of the Northern Departments at Lille, died of blood poisoning contracted in his hospital work on December 26, at the age of forty-three years.

Professor Chiyomatsu Ishikawa, honorary professor of zoology at the Tokyo Imperial University, died at the age of seventy-four years on January 17, in Taihoku, Formosa, Japan.

SCIENTIFIC EVENTS

CONGRESS FOR PREHISTORIC RESEARCH IN THE FAR EAST

ARRANGEMENTS have been completed for a meeting at Manila of the second Congress for Prehistoric Research in the Far East—officially known as the "Deuxième Congrés des Préhistoriens d'Extreme Orient"—which will be held under the joint auspices of the University of the Philippines and the Bureau of Science, from February 6 to 12.

Governor-General Murphy recently invited the governments of Japan, China, French Indo-China, Siam, Netherlands Indies, Hongkong, the Federated Malay States and British Borneo to send official delegates to the congress. It is understood that the following institutions will also be represented by one or two delegates each:

The Oyama Institute of Prehistory, Tokio; the Universities of Tokyo, Sendai and Kyoto, Japan, and the University of Taihoku, Formosa.
The Geological Survey and the National Research Institute, of China, both at Peking.
The University of Hongkong.
Ecole Française d'Extreme Orient, and the Geological Survey of French Indo-China, both at Hanoi.
The Royal Siamese Institute of Literature, Arts and Archeology, Bangkok.
The Batavia Society of Arts and Sciences, and the Bureau of Anthropology for the Netherlands Indies, Java.
The Bishop Museum of Honolulu, and
The Federated Malay States museums at Taiping and Singapore.

This congress was originally scheduled to be held at Bangkok in January, 1935. Disturbed political conditions in Siam, however, and recent changes in the government there, caused the executive committee of the congress to transfer it to Manila, and to postpone the date until February.

The Philippines will be represented by three delegates at the congress—one from the university, one from the Bureau of Science and one representing American students of Far-Eastern prehistory.

Leading archeologists and students of the ancient history of the Far East, as well as a number of geologists and explorers, have already signified their intention of attending.

Some of the principal features of the tentative program are:

1. Reviews of recent prehistoric and protohistoric research in China, Japan, Formosa, Hongkong and vicinity, French Indo-China, Siam, the Malay Peninsula and the Netherlands Indies, the Philippines and the Pacific Islands; by one delegate from each of these regions. (For the delegates and associate members only.)

2. Three or more open meetings, at which papers of general interest, relating to recent discoveries in the Far East, will be read.

3. A series of round-table conferences, at which special topics will be taken up by small groups of interested delegates and associate members.

The proceedings of the second congress, and the more important papers read, will be later published—probably in a volume to be issued by the university or the Bureau of Science some time before the end of 1935.

It may further be stated that the congress was an outgrowth of the Pacific Science Congress, and was originally organized in connection with the Java meeting of that congress in 1929–30. The first independent meeting was organized by the Government of French Indo-China, Hanoi, 1932.

H. OTLEY BEYER,
Chairman, Philippine Committee

THE THIRD INTERNATIONAL CONGRESS OF SOIL SCIENCE

THE third International Congress of Soil Science will be held at Oxford, England, from July 30 to August 7, this year under the presidency of Sir John Russell. The two previous congresses of the series were held in Washington in 1927 and in Leningrad and Moscow in 1930, and were notable for the exceptionally international character of the personnel and the discussions. The congress will meet as a whole in six plenary sessions, at which a general survey of recent advances in every branch of soil science will be made, and it will also work in sections or "Commissions" dealing specifically with soil physics (I), chemistry (II), biology (III), fertility (IV), classification (V) and technology (VI). Three sub-commissions will discuss problems relating to alkali, forest and peat soils, respectively. A 16-day excursion round Great Britain leaving Oxford immediately after the congress, and terminating in Cambridge on August 23 is being arranged for the benefit of members wishing to obtain first-hand knowledge of British agriculture and soils.

Every member of the congress will receive a copy of the official transactions, including the full text of papers read at the plenary sessions, and detailed reports of the discussions at the commission sessions. The cost of the *Transactions* will be included in the Congress fee (£2), payment of which will also entitle members to attend all meetings, receptions, etc., held in connection with the congress. Accommodation during the congress in an Oxford College may be reserved through the organizing committee, or privately in hotels or boarding houses.

Intimation of attendance at the congress should be

sent as soon as possible to the Secretary of the Organizing Committee, G. V. Jacks, Imperial Bureau of Soil Science, Harpenden, England, from whom all further information may be obtained.

REPORT OF DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

DR. E. D. MERRILL, director of the New York Botanical Garden, pointed out to members of the board of managers at the annual meeting on January 14 that naturalistic planting of tropical subjects in the greenhouses has been one of the important horticultural developments at the New York Botanical Garden during the past year.

The cactus house in Conservatory Range 1, which has been closed to the public for several weeks, will be re-opened this month, with all the plants set out in a desert garden as though they were growing out of doors in their native habitat. Other succulents, which were planted in naturalistic fashion in the adjoining house last year, have grown luxuriantly. In early spring, the collection of bananas and their allies will be on view in a humid, tropic house where they are now being replanted.

Bordered with suitable shrubs, trees and smaller plants from cooler regions of the world, a new rock-bound pool has replaced the old formal pool at the entrance to Conservatory Range 2 on the east side of the grounds. Collections of orchids and begonias, two of the featured types of plants in other parts of this conservatory, have been greatly improved the past year.

In anticipation of a magnificent display of flowers in the new Thompson Memorial Rock Garden, 7,500 bulbs for early spring bloom were planted last fall. These will be seen in addition to hundreds of primulas and other flowers which were first brought into bloom there last spring.

A gift of 450 evergreen trees received from Colonel Robert H. Montgomery has been used largely for new background plantings. In addition, Colonel Montgomery presented 85 species and varieties of evergreens which are now being raised for the garden at the Boyce Thompson Arboretum.

Ornamental trees and shrubs figured largely in a gift of a carload of nursery stock—1,445 items—from the Farr Nursery Company of Pennsylvania. The trees in the natural hemlock forest bordering the Bronx River at the Botanical Garden have been increased by the planting of 300 specimens four to five feet high. Other new plantings include the borders of the park, where work has been done partly in cooperation with the city, which has provided the means for improvements in many parts of the grounds.

A body of women workers from the Emergency Relief Bureau has helped the New York Botanical Garden to build up, in the last few years, one of the largest and most readily accessible collections of herbarium specimens in the world. While two or three other herbaria slightly exceed the New York one in size, none has so efficient a system of references.

The Botanical Garden's herbarium, with 70,000 specimens having been mounted and added to the collections by emergency workers during 1934, now numbers 1,800,000 specimens.

Dr. Merrill also announced that the year's additions to the library bring the number of bound volumes above 44,000, enabling it to hold its place as the largest combined botanical and horticultural library in America.

The course for professional gardeners, inaugurated in 1932 by the New York Botanical Garden, entered its third year last fall with a record enrolment of seventy-two students. Gardening courses for amateurs, courses of study on ferns and trees, and Saturday afternoon lectures given in all but the summer months have been among other educational activities. Scientific work prosecuted during the year has included the study of specific plant diseases and their control, and the breeding of new varieties of day lilies, southern iris and lilies, besides the work on seedless grapes being carried out in cooperation with the Geneva Experiment Station.

Many improvements in buildings and grounds have been initiated with the help of men from the Emergency Relief Bureau. Among other workers from this group in the Museum Building, there have been artists, librarians, technicians, stenographers, typists, clerks, and others, who have been of great assistance to the scientific staff.

An innovation in memberships approved at the meeting is a garden-club membership, by which a group, for an annual fee of $25, is accorded special privileges offered by the institution.

FELLOWSHIPS IN MEDICINE OF THE NATIONAL RESEARCH COUNCIL

FELLOWSHIPS in medicine, administered by the Medical Fellowship Board of the National Research Council, will be available for the year beginning on July 1. These fellowships are open to citizens of the United States and Canada who possess an M.D. or Ph.D. degree. They are intended for recent graduates and not for persons already professionally established.

The fellowships are designed to provide research discipline for men and women who are fitted for research in the medical sciences. At present candidates will be favored who plan to specialize in one of the sciences related to medicine or to approach clinical medicine and surgery through temporary identification with one of these sciences.

The choice of place to work in is left to the fellow, subject to the approval of the Fellowship Board; but as a rule fellows will be expected to work in this country. Ordinarily before sending his application to the board, a candidate should have assurance from the person with whom he wishes to work that he is acceptable.

The appointments are for full time and no other remunerative work is permitted. The usual basic stipends awarded are $1,800 a year for unmarried fellows and $2,300 for married fellows.

Fellows will be chosen at a meeting of the Medical Fellowship Board in April. Applications to receive consideration at this meeting must be filed on or before March 1. Appointments may begin on any date determined by the board.

Further particulars concerning these fellowships may be obtained on request. All communications should be addressed to the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.

FRANCIS G. BLAKE, *Chairman*
DIVISION OF MEDICAL SCIENCES
NATIONAL RESEARCH COUNCIL

THE NEW DEAN OF THE YALE SCHOOL OF MEDICINE

DR. MILTON C. WINTERNITZ, whose term of office as dean of the Yale School of Medicine expires in June, has declined to be considered for reappointment. To succeed Dr. Winternitz, Dr. Stanhope Bayne-Jones, professor of bacteriology in the faculty of medicine, has been appointed dean for a period of five years beginning on July 1.

The following resolution, adopted at the January meeting of the Yale Corporation, was also made public:

> To record the enduring gratitude of the President and Fellows to Professor Milton C. Winternitz for his outstanding services to the University and the New Haven Hospital during the fifteen years he has served as dean of the School of Medicine, and to express their hope that he may long continue his association with the community, and the University to which he has in his work made such notable contributions.

Dr. Winternitz, who is professor of pathology, came to Yale University from the Johns Hopkins University. He has been a professor in the Yale Medical School since 1917, was first appointed its dean in 1920 and has served as such for three successive five-year terms. From this country and abroad the following members have been added in recent years to its faculty: Professors J. G. Dusser de Barenne from Utrecht; John F. Fulton from Oxford; Eugen Kahn from Munich; Edgar Allen from the University of Missouri; Walter R. Miles from Stanford University, and Harvey Cushing from Harvard University.

The physical plant of the school and of the New Haven Hospital, with which it is affiliated, has been practically rebuilt and greatly enlarged by gifts for these purposes from friends of the school and from some of the great foundations, resulting from the leadership of Dr. Winternitz. In addition he was one of the prime movers in the establishment of the Institute of Human Relations.

In general support of the program developed by Dr. Winternitz, the endowment of the School of Medicine has been increased from about $2,000,000 to over $8,000,000 by gifts made during his deanship.

Dr. Winternitz will continue his work in the school as professor of pathology.

Dr. Bayne-Jones, who is professor of bacteriology and master of Trumbull College, took his B.A. degree at Yale in 1910, and his M.D. at the Johns Hopkins University, where he studied under Dr. Winternitz. During the war he served as Medical Officer with the British Expeditionary Forces for ten months; later was with the Twenty-Sixth Division of the A. E. F., and finally with the rank of major as sanitary inspector of the Army of Occupation. He received the British Military Cross and the Croix de Guerre. He was associate professor of bacteriology at the Johns Hopkins Medical School from 1919 to 1923. He came to Yale from the University of Rochester where he had been professor of bacteriology for eight years. While there he was director of the Rochester Health Bureau Laboratories.

THE ROCHESTER MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA

THE forty-seventh annual meeting of the Geological Society of America was held at the University of Rochester, from December 27 to 29.

The meeting was one of the largest in the history of the society. One hundred and twenty-two scientific papers were presented before the Geological Society, and the programs of the associated societies meeting with it, the Paleontological Society and the Mineralogical Society of America, were also crowded.

The address of the retiring president, W. H. Collins, geology and literature, was delivered the evening of December 27, followed by the annual smoker. The annual dinner was held at the Hotel Seneca on the 28th. The seventh award of the Penrose Medal was made at the dinner, the recipient being Professor Charles Schuchert, of Yale University.

The officers of the society for the year 1935 are:

President, Nevin M. Fenneman.
Past-president, W. H. Collins.

Vice presidents, Edson S Bastin Donnel F Hewett, John B Reeside Jr Austin F Rogers
Secretary, Charles P Berkey
Treasurer Edward B Mathews
Councilors Frank F Grout W O Hotchkiss, Joseph Stanley Brown, F W DeWolf, Donald H Mc Laughlin Adolph Knopf Walter H Bucher Russell S Knappen E L Bruce

The following geologists were elected foreign correspondents Arthur L Hall, assistant director of the Geological Survey of the Union of South Africa, Olaf Holtedahl, professor of paleontology, University of Oslo Paul Niggli, professor of mineralogy and petrography, University of Zurich Giuseppe Stefanini, professor of geology, Royal University of Pisa Announcement was made of the election of twenty two fellows The total membership of the society is 685 Following is the list of newly elected fellows Thomas Laval Bailey Los Angeles, Milton Nunn Bramlette, Washington, D C, William Horatio Brown, Gilman, Colorado, Theodore Chapin, Los Angeles, California, Louis Wade Currier, Washington, D C, Robert Henry Dott, Tulsa, Oklahoma, George Malcolm Fowler, Joplin, Missouri, George Herbert Girty, Washington, D C Waldo Sumner Glock, Tucson, Arizona, Arthur Pharaoh Honess, State College, Pennsylvania, Henry Van Wagenen Howe, Baton Rouge, Louisiana, Richard E Koch, The Hague, Holland, James Bernard Macelwane, St Louis, Missouri, Robert John Burgoyne Newcombe, Lansing, Michigan, Francis John Pettijohn, Chicago, Illinois, John Frank Schairer, Washington, D C, Laurence Lowe Smith, Columbia, South Carolina, Grace Anne Stewart, Columbus Ohio, Francis Gerritt Wells, Washington, D C, Maynard Pressley White, Ardmore, Oklahoma, James Steele Williams, Washington, D C, Walter Byron Wilson, Tulsa, Oklahoma

SCIENTIFIC NOTES AND NEWS

ON the occasion of the celebration of the one hundred and fiftieth anniversary of the Asiatic Society of Bengal twelve special anniversary honorary members were elected, including, in science Albert Einstein, Sir Ernest Rutherford, Henry Fairfield Osborn, A Lacroix and Sven Hedin

DR AMBROSE SWASEY, chairman of the board of the Warner and Swasey Company, will be the recipient of the Washington Award for 1935, which will be presented at a joint meeting of the Engineering Societies to be held in Chicago during the week of February 17 The award was founded by John W Alvord in 1916, and is given "in recognition of accomplishments which preeminently promote the happiness, comfort and well being of humanity and as the recognition of an engineer by his fellow engineers"

DR. JOSEPH S AMES, president of the Johns Hopkins University, has received the award of the Langley Gold Medal of the Smithsonian Institution, in recognition of his work as chairman of the National Advisory Commission for Aeronautics, a position he has held since 1917

THE honorary doctorate of the University of Brussels has been conferred by the faculty of sciences on Dr Peter Debye, professor of experimental physics at Leipzig, and on Dr Adolf Pascher, professor of botany in the German University at Prague

IN celebration of the seventy first birthday of Sven Hedin, the explorer, it is planned to publish in Sweden a volume in his honor, which will be written by other explorers. Crown Prince Gustaf Adolf of Sweden is at the head of the group that has issued an invitation for public subscriptions

ARTHUR S TUTTLE, New York state engineer for the Federal Emergency Administration of Public Works and formerly chief engineer with the Board of Estimate and Apportionment of New York City, has been elected president of the American Society of Civil Engineers Harrison P Eddy is the retiring president

THE following officers and councilors were elected at the annual meeting of the Society of American Bacteriologists held in Chicago, from December 27 to 29 *President*, Dr Karl F Meyer, director of the Hooper Foundation of the University of California, *Vice president*, Dr Thomas M Rivers, member of the Rockefeller Institute for Medical Research, *Secretary treasurer*, Dr I L Baldwin, professor of agricultural bacteriology, the University of Wisconsin, *Councilors*, Dr Lloyd D Felton, assistant professor of preventive medicine and hygiene, the Harvard Medical School, and Dr Stewart A Koser, assistant professor of bacteriology, the University of Chicago The next meeting will be held in New York, from December 26 to 28

DR FRANK D DICKSON, of Kansas City, Missouri, was elected president of the American Academy of Orthopedic Surgeons at the meeting in New York on January 14. He succeeds Dr Philip D Wilson, of New York City Dr Melvin S Henderson, of the Mayo Clinic, has been elected president of the American Board of Orthopedic Surgeons, a new board organized at the meeting

AT the annual program meeting of the Northwest Scientific Association in Spokane, Washington, on December 28 and 29, the following officers were elected: *President*, W. A. Rockie, Soil Experiment Station, Pullman, Washington; *Vice-president*, Thos. Bonser, curator, Spokane Museum, Washington; *Secretary-treasurer*, O. W. Freeman, State Normal School, Cheney, Wash. The meeting for 1935 will be held at the Davenport Hotel in Spokane, on December 27 and 28. A special symposium will be held on problems of soils and soil erosion.

WAYNE M. FAUNCE will fill the vacancy of vice-director of the American Museum of Natural History, created through the promotion of Dr. Roy Chapman Andrews to the directorship. Other promotions approved by the trustees include that of Dr. E. W. Gudger, from bibliographer and associate to associate curator of living and extinct fishes; Francesca R. La Monte, from assistant curator to associate curator; Marcelle Roigneau, from staff assistant in comparative anatomy to assistant curator of comparative and human anatomy; Hazel Gay, from acting curator of library and publications to librarian; John T. Zimmer, from associate curator of birds of the western hemisphere to acting curator.

DR. ELLEN FITZ PENDLETON, formerly associate professor of mathematics at Wellesley College and since 1911 its president, has tendered her resignation to take effect in June, 1936.

DR. JAMES FRANCK, formerly professor of physics, University of Göttingen, now at the University of Copenhagen, has been appointed professor of physics at the Johns Hopkins University. Dr. Franck served in the German army in the war and seven years ago received the Nobel Prize for his work in physics.

DR. LEONARD CARMICHAEL, professor of psychology at Brown University, has been appointed lecturer in psychology at Harvard University for the second semester.

THE Committee on Scientific Research of the American Medical Association has made a grant in aid of research to Dr. S. S. Lichtman on the metabolism of bile salts in health and in disease of the liver and bile passages. The work will be carried on in the Mount Sinai Hospital, New York City.

DR. BUNJIRO TERADA, associate professor of pharmacology in the Manchurian Medical College, Mukden, Manchuria, has arrived in San Francisco under a fellowship of the Rockefeller Foundation for a period of study and research in the department of pharmacology, Stanford University School of Medicine.

THE Rockefeller Foundation has made a grant to Dr. Harry R. DeSilva, professor of psychology at Massachusetts State College, to construct a cathode ray oscillograph and a thyratron electrical stimulator to be used in the study of action currents in the human body which do not enter the higher brain centers.

PROFESSOR R. A. EMERSON, of the New York State College of Agriculture at Cornell University, is spending a part of his sabbatic leave in Yucatan, Mexico, with J. H. Kempton, of the U. S. Department of Agriculture, under the auspices of the Carnegie Institution of Washington and the U. S. Department of Agriculture, in a preliminary study of the wild relatives of *Zea Mays*. It is hoped also that materials of interest in a study of the genetics of maize and its relatives may be found. After the trip to Yucatan, Professor Emerson will visit the laboratories of genetics and plant breeding in California and several of the southern and middle western states.

PROFESSOR C. A. EDWARDS, of Swansea, Wales, lecturer for the American Institute of Metals, will give two lectures at the Carnegie Institute of Technology, Pittsburgh, on February 28 and March 1. He will discuss the factors governing the growth of metallic crystals and the effects of crystal size upon the properties of metals at his first lecture. The second lecture will deal with the influence of cold-rolling and annealing upon the properties of mild steel sheets.

THE Harry Burr Ferris lecture in anatomy at Yale University was given this year by Dr. Robert Chambers, professor of biology at New York University, on the "Mechanics of Cell Division." The lecture was illustrated by micro-moving pictures of dividing cells manipulated by a micro-dissection technique.

DR. MEL T. COOK, of the Rio Piedras Experiment Station, Puerto Rico, lectured at the Johns Hopkins University on January 8 on "West Indian Hurricanes, their Origin and their Effects."

DR. EDWARD KASNER, professor of mathematics at Columbia University, will address the Galois Institute of Mathematics at Long Island University on January 26 on "Transcendental Numbers."

DR. P. J. HANZLIK, professor of pharmacology at the Stanford University School of Medicine, San Francisco, recently delivered a series of graduate lectures on pharmacology and therapeutics, under the auspices of the Seattle General Hospital and King County Medical Society in Seattle.

A LECTURE entitled "Experience on a Stratosphere Flight," illustrated by both moving and stationary pictures, was given at the Franklin Institute, Philadelphia, on January 10, by Mr. and Mrs. Jean Piccard.

DR. J. B. S. HALDANE, professor of genetics at the University of London and head of genetical research

at the Johns Innes Horticultural Institution, has been appointed to deliver the twelfth annual William Thompson Sedgwick memorial lecture at the Massachusetts Institute of Technology on Friday, January 25. He speaks on "Some Problems of Mathematical Biology" in the main lecture hall of the institute at 4:30 P. M. The lecture will be open to the public. The Sedgwick Memorial lectureship was established in 1922 in commemoration of the services of Professor William T. Sedgwick to the cause of biology and public health.

DR. LOTHAR NORDHEIM, formerly at Göttingen, now in Holland, will lecture during the summer session at Purdue University on "Modern Developments of Quantum Mechanics and Nuclear Physics."

THE twelfth International Congress of Sociology will be held under the auspices of the International Institute of Sociology of Geneva in connection with the Universal Exposition at Brussels, from August 25 to 30. The secretary of the congress is Professor G. L. Duprat, of the University of Geneva. Professor Charles A. Ellwood, of the department of sociology at Duke University, is the president of the International Institute for next year and will preside at the congress.

THE Midwestern Psychological Association will hold its tenth annual meeting as guest of the department of psychology at the University of Kansas on May 10 and 11.

BY the will of Alba B. Johnson, formerly president of the Baldwin Locomotive Works, the Jefferson Medical College and Hospital will receive $250,000. He was president of the college.

DIRECTORS of the Boxer Indemnity Fund have made a grant of $10,000 to the Catholic University of Peiping, China, to aid the department of micro-biology in anti-typhus research.

COLUMBIA UNIVERSITY has announced gifts amounting to $47,868. The Carnegie Corporation has given $17,500 for dental research. Gifts of $2,000 and over include: $5,000 from the Brain Research Foundation for the department of neurology; an anonymous gift of $2,500 to establish a fund to be known as the "fund for studies in Endocrine-Cytology in the Department of Anatomy"; an anonymous gift of $3,000 to establish a fund to be known as the "Special Surgical Bacteriological Research Fund in the Department of Surgery." The Committee of Citizens of Holland gave $2,000 for the Queen Wilhelmina Professorship.

THE University of California has received $50,000 from the estate of Mrs. Jean Conrad. Among the other larger gifts were: Robert P. Scripps, Cincinnati, $4,200 for the Scripps Institution of Oceanography at La Jolla; Eli Lilly Company, Indianapolis, $2,400 for the study of leprosy in the Medical School.

IT is noted in the *Bulletin* of the Institute of International Education that the Institute of Parasitology of MacDonald College, Quebec, which was recently dedicated, is said to be the only institute in the world built especially for the study of animal parasites. The Quebec Government provided the building, and the National Research Council will maintain the institute. A portion of the building has been in operation for some time, and has been drawing its research material from stock maintained locally, from collectors stationed in every province, including the Northwest Territories situated within the Arctic Circle, from the Quebec Zoological Gardens, and from individual naturalists, stock owners and others throughout the Dominion and in the West Indies, as well as from other parts of the Empire.

DR. BERNHARD ZONDEK, formerly of Berlin, the well-known gynecologist, has become the head of the gynecological and obstetrical departments of the Rothschild-Hadassah Hospital in Jerusalem. He has assumed his work in the renovated, modernized and enlarged obstetrical pavilion of the hospital with laboratories at his disposal to continue his research. Dr. Zondek, who is co-discoverer of the Ascheim-Zondek test used in the diagnosis of pregnancy, was formerly the head of the department of gynecology of the Hôpital de Charité of the University of Berlin up to the time of the Hitler régime. When the Nazi government came into power, he and his two equally well-known brothers, Drs. Hermann and Samuel Zondek, went to Manchester, England. When the Rothschild-Hadassah-University medical center is built on Mt. Scopus, new laboratories will be equipped for the research of Dr. Zondek. He will not only be head of the gynecological and obstetrical departments of the new hospital, but will be professor of gynecology in the post-graduate medical school, which will be a part of the medical center. His research work in Palestine will be partly financed by a grant of $2,000 from the Rockefeller Foundation. Nine other German exiled physicians were added to the staff of the hospital during the past year. Among these is Professor Ludwig Halberstädter, who brought the first supply of radium into Palestine. He is director of the new Institute of Radiology in Jerusalem. Thirty other German physicians are studying in the hospitals and clinics.

To make "deep fish" soundings in a lake 5,000 feet above sea level, and to collect birds, plants and small mammals for the Academy of Natural Sciences of Philadelphia, Mr. and Mrs. Rodolphe M. de Schauensee, accompanied by Waldemar Fioravanti, of Flor-

ence, Italy, left on January 20 for two months of exploration in the central highlands of Guatemala. The expedition will be joined by Brando Barringer and Reginald Jacobs, of Philadelphia, who will make the round trip by airplane. Lake Atitlan is high set among the mountains, with a known depth of more than 1,000 feet. With a specially constructed wire trap lowered by reel, Mr. de Schauensee, who is one of the curators in the department of vertebrate zoology of the academy, will seek to secure additions to the few species of fishes now recorded from this body of water, which may be much deeper than it now is believed. The expedition has permits to collect rare orchids which are found in that part of the country.

DISCUSSION

THE WHITNEY SOUTH SEA EXPEDITION

THE work of the American Museum's Whitney South Sea Expedition in collecting birds in the New Zealand region from December, 1925, to April, 1926, for unexplained reasons has aroused much unwarranted criticism. The charges brought against us are so often untrue or admittedly based on hearsay that they have seemed to us to be unworthy of attention, but they continue to be made and, in some instances, to involve other American museums. It seems desirable, therefore, that we should reply to those which are sufficiently definite to make a reply possible. It is remarkable that in no single instance have these charges been made direct to the American Museum. If they had been, we should have replied to them at once. We have nothing to conceal, and if excess of zeal should have led our collector to violate the ethics of his profession, we should be among the first to admit and to regret it. But invariably these accusations have reached us through a third or fourth person or in some publication. For this reason, as well as from the nature of some of the criticisms, we conclude that neither the affiliations nor the objects of the Whitney Expedition are known to those who have attacked it. They should, therefore, be stated before these attacks are replied to.

In 1920 the American Museum of Natural History of New York City, under a fund provided by the late Harry Payne Whitney, inaugurated an ornithological survey of the islands of the Pacific. This was designed to include a comprehensive view of the avifauna as a whole and an intensive study of the birds of all the more important islands, the whole being intended to help solve the problems connected with the origin and development of insular faunas. The field work was entrusted to Rollo H. Beck, a leader among American bird collectors, who from 1913 to 1917 had served the museum with marked success on the coasts of South America and in the West Indies.

Mr. Beck began his labors at Papeete in 1920 and, in command of the 75-foot Tahitian schooner *France*, continued as the leader of the expedition until 1928, making what is doubtless the longest ornithological voyage in history. During this period he secured in the aggregate a large number of specimens, but when it is remembered that he visited not less than 600 islands and islets, and over 1,000 localities, it will be realized that the number secured at each station is not in excess of the needs of science. And we add, with all possible emphasis, that in no case has our work endangered the existence of a species or materially affected its numbers. It should also be remembered that while Old World museums are often well supplied with birds from the area visited, American museums were usually without them. Contained in our collections, they are now available to our sister museums.

Thus far 44 papers have been published on the work of the Whitney Expedition. They mark merely the beginning of researches which are now being conducted by an associate curator who has been placed on our staff especially to study the Whitney Expedition collections. Attention should also be called to the fact that the success of the expedition induced its patron to offer to the City of New York the sum of $750,000 if it would appropriate an equal amount for the construction of an addition to the museum to be devoted exclusively to the museum's department of birds. This building, known as the Whitney Wing, is now completed and will be occupied during the coming year. One entire floor in it will be given to habitat groups illustrating the bird-life of the Pacific. At this moment an expedition on the yacht *Zaca*, under the command of its owner, Mr. Templeton Crocker, is making studies and securing accessories for these exhibits.

It is also pertinent to state that after Mr. Whitney's death his wife and children purchased and presented to the American Museum, in his memory, the unique Rothschild collection of birds. It may, therefore, be said that directly and indirectly the Whitney South Sea Expedition is one of the most notable undertakings in the annals of ornithology.

I turn now to the charges that have been made against this expedition. They are usually so unfounded or seem to us to be so trivial that if they did not, in some instances, reflect on other American museums we should not feel justified in asking space in which to reply to them.

Thus, for example, in a pamphlet issued by the

New Zealand Bird Protection Society in 1926 (p 4), it is said "we understand at least two museums are interested in the present [Whitney] Expedition and that there are more to follow, so the matter better be threshed out at once as to whether the authorities are to be permitted to thus distribute the people's heritage to foreigners" Various references are also made to the 'monetary value" of the specimens collected, to the institutions in America backing the expedition

In a letter from England to Dr Henry B Ward, permanent secretary of the American Association for the Advancement of Science Beck is referred to as a "dealer in bird skins The truth is that the American Museum is solely responsible for the Whitney Expedition and that, with the exception of certain specimens given to government authorities, and in one case to an artist, all the specimens collected by the expedition were sent to the American Museum

The character of much of the criticism directed toward the expedition is reflected in the following communication

"Have you heard Sydney Porter's story of the American Whitney expedition which has been going around all the islands in the South Seas where there are very rare birds and wiping them right out to provide specimens for the countless American museums? He says they have exterminated the Antipodes Island Parrakeet and flightless snipe, the Norfolk Island Parrakeet, the Masked Parrakeet (they killed 18 and none have been seen wild since), the Fijian aureocinctus lorikeet and the lovely blue lorikeets I hoped one day to be able to afford to send a collector to obtain a few live pairs of! I hope there may be some exaggeration, but I fear it is all too likely as one knows what American collectors are I think, anyhow, we should let American ornithologists know our unvarnished opinion of the whole business if anything of the kind has really happened If they were afraid of the birds dying out before enough museum specimens had been secured if they had caught a few pairs of the parrakeets *alive* they could have bred them in the wonderful California climate, got all the specimens they wanted, and saved the species as well" (April 2, 1934)

Evidently we have here the source on which the Marquess of Tavistock based his attack on the Whitney Expedition published in *The Auk* for July, 1934 The same issue of that magazine contained my reply to him and as briefly as possible, therefore, I state here that of the Antipodes parrakeet (*Cyanoramphus unicolor*) we collected 2 specimens, of the snipe (*Coenocorypha aucklandica tristrami*), 2, of the Norfolk Island parrakeet (*Cyanorhamphus verticalis*), 2, of the Fijian parrakeet (*Charmosynopsis aureocincta*), 12, of the masked parrakeet, 26, and of the very common, widely distributed blue lorikeet (*Vini peruvianus*), a representative series from 8 islands

It should be admitted that the number of masked parrakeets secured is in excess of our needs However, Vitu Levu, the island it inhabits, is larger than southeastern England and the greater part of it is still unexplored The fact that in a brief visit Beck could have secured so large a series of this forest inhabiting species is evidence of its abundance, while the restriction of his labors to a limited part of its range indicates that he could not have seriously affected its numbers

The suggestion that we breed parrakeets and thereby base our studies of geographical variation and insular evolution on aviary specimens merely demonstrates its maker's ignorance of the requirements of science

I append now serially other charges together with our replies to them

(1) 'When the Expedition arrived in New Zealand waters instead of making straight for Auckland or Wellington to ask for permission to collect birds, they delayed their arrival, staying in the Hauraki Gulf and collecting birds on the island sanctuaries, the homes of the rarest of the New Zealand birds, where one may not even land without permission from the Government Previous to this they collected in the Chatham Islands, where all the birds are protected by the New Zealand Government"

This is untrue The expedition arrived in New Zealand in December, 1925, and no collecting was done there until December 17, the date on which our permit was issued Chatham Island was not visited until March 4, 1926, nearly three months later No collecting was done in the Hauraki Gulf or its sanctuaries

(2) It has been said that in many instances Beck collected more specimens than his permit allowed

This is unfortunately true of his work on Chatham Island There our permit granted permission to take four specimens each of *Hapolorhyncus albofrontatus*, *Petroica macrocephala* and *Rhipidura flabellifera*, and the expedition secured eight, nine and eight specimens, respectively, of these species It should be recalled, however, that when several members of an expedition take to the field independently they can not be acquainted with one another's doings until they return to headquarters While no individual, therefore, may exceed the prescribed number of a given species, their work as a whole may do so As evidence that in the aggregate the expedition's activities on Chatham Island did not make excessive demands on its bird life, it should be stated that while our permit allowed us 44 specimens of 9 land birds, we collected but 38 It should be added that specimens of the "excess" species were presented by Beck to the

New Zealand Dominion Museum from which we hold due acknowledgment.

(3) "The ship landed at the Antipodes and did great slaughter, especially among the Royal Albatrosses (*Diomedea epomophora*) which at that time were nesting. Many times the dinghy (the small boat from the ship) was so loaded with bodies that it almost sank" (letter to Dr. Ward).

This statement is exaggerated. Beck collected 17 specimens of the royal albatross, not at Antipodes but at the Chathams and in surrounding waters. Two of these have been given to the Cleveland Museum, two to the Museum of Comparative Zoölogy in Cambridge, two to the Bishop Museum in Honolulu and one to the Royal Zoological Museum in Stockholm, leaving ten in the American Museum, not an excessive number of an abundant species.

(4) "I also met someone in Norfolk Island who was residing there when the Expedition called, and he said that the Norfolk Island Parrakeet (*C. cooki* = *C. verticalis*) which was at that time common was almost wiped out and only during this last year or two have any been seen. This also happened to the Norfolk Island Robin" (letter to Dr. Ward).

The expedition secured two specimens of the parrakeet, as stated above, and 15 of the robin, a common species.

(5) "Numbers of skins of the nearly extinct Sand Plover (*Thinornis novaeseelandiae*) were obtained and also the skins of other very rare birds" (letter to Dr. Ward).

Our permit allowed us to collect 10 specimens of this plover; Beck took but six.

(6) "The Expedition, however, raided the Kermedecs without asking any permission. . . ." "A permit was obtained and they sallied forth raiding our islands, with the result we found some rare birds were exterminated, such as the Antipodes Parrakeet" (letter of E. V. Sanderson, Hon. Secy N. Z. Native Bird Protection Society to International Wild Life Protection Society, Cambridge, Mass.).

It is true that Beck landed on the Kermedecs before he had received his collecting permit. He passed these islands on his voyage from Fiji to New Zealand, from which they are distant about 600 miles. To have visited New Zealand first and then returned to the Kermedecs would therefore have added 1,200 miles to his journey. He was now so far south of the latitudes in which his vessel was built to cruise that every day added to the length of his journey increased its risks. He can perhaps, therefore, be excused if he made his collections in advance of the permit that was subsequently granted him. Beck's "raid" on the Kermedecs consisted in collecting 27 specimens of land-birds, none of them representing rare species.

Of the Antipodes parrakeet, as already stated, Beck collected 2 specimens. Since his visit to the island in 1926, Oliver ("New Zealand Birds," 1930) writes that this species is common there. Mr. Sanderson's charge that Beck exterminated this bird is evidently, therefore, unfounded.

This covers the more tangible charges of which we are aware. I am confident that if our critics had been more accurately informed of the results of our labors and more fully acquainted with our objectives, they would have been more discriminating in their accusations.

FRANK M. CHAPMAN,
Curator, Department of Birds, American Museum of Natural History, New York City
NOVEMBER 20, 1934

THE WESTERN INVASION OF SAMIA CECROPIA

THE Cecropia moth is one of the most familiar insects of the United States, native from Canada to Florida, and west to Nebraska. When Packard's memoir on the Saturniidae was published (1914), it was not known in Colorado, that region being occupied by another species, *Samia gloveri,* which could be found from the foothills to the high mountains, and was common. When "The Zoology of Colorado" was published (1927) *S. cecropia* had invaded the eastern plains of that state, and was reported to be destructive in orchards. Soon after, it began to appear in other parts of Colorado, and now it is abundant at Boulder, as indicated by the numerous specimens brought to the university each summer. Since *S. cecropia* came in, I have not seen a single *S. gloveri.* The last actual date I have for *S. gloveri* is Estes Park, 1917, collected by Mrs. R. S. Tallant. I presume that *S. gloveri* still exists in the mountains, but it seems to have disappeared where *S. cecropia* has appeared. The specimens of *S. cecropia* do not appear to be hybrids, or at any rate are distinctly *S. cecropia* and not *S. gloveri.* It is probable that *S. cecropia* is twice or three times as abundant as *S. gloveri* ever was, but even so, it leaves plenty of room and plenty of food for the latter species.

Mr. Walter R. Sweadner, of the University of Pittsburgh, has just published (*Entomological News,* November, 1934) a very interesting article which seems to throw important light on this problem. He found, in Montana, that *S. cecropia* would mate with *S. gloveri* in a state of nature, and he even observed a male *S. gloveri* mated with a female *S. cecropia,* while a female *S. gloveri* a few feet away remained unmated. Raising various *Samia* hybrids, he found that the females were sterile, but the males would mate with one of the parent species and produce healthy offspring. Now it would seem that if *S. cecropia* invades the territory of *S. gloveri,* and is two or three

times as abundant as that species, and there is no obstacle to crossing, then the great majority of *S. gloveri* will mate with the wrong species, and the females so produced will be sterile. The males will usually mate with *S. cecropia*. Thus *S. gloveri* will disappear, but the critical examination of numerous specimens should show traces of *S. gloveri* ancestry. I offer this note at the present time because it is important that all entomologists living in the Rocky Mountain region should be aware of what is going on, and should collect specimens and make observations throwing light on a case which may well become classic in the annals of biology.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

THE RING STRUCTURE OF THYMIDINE

THE detailed structure of the nucleic acid molecule can not be formulated without knowledge of the ring structure of the constituent nucleosides, which, for nucleosides of the desoxyribose type, has not yet been established. In the case of ribose nucleosides, the furanoside ring structure has been shown by two methods, one based on methylation of the nucleosides, the other on the formation of a mono-trityl derivative. It was found that in the pure mono-trityl derivative, the trityl group is located on the primary alcoholic group of the sugar.

The latter method has now been applied to the study of the ring structure of thymine-2-desoxyriboside. A pure mono-trityl derivative was obtained and thus the conclusion is warranted that the desoxyribose nucleosides likewise have the furanose structure.

The properties of mono-trityl thymidine are as follows: m.p. 125°; $[\alpha]_D^{24} = +11.4°$ (in acetone).

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SOCIETIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE thirty-fifth meeting of the Tennessee Academy of Science was held in Nashville, Tennessee, at Vanderbilt University, on Friday and Saturday, November 30 and December 1, 1934. In cooperation with the academy, its affiliated societies, the Tennessee Ornithological Society and the Tennessee Barnard Astronomical Society, held their annual meetings and contributed papers to the program.

Classification of the papers shows: Anatomy 2, astronomy 2, bacteriology 1, biochemistry 3, biology 9, chemistry 2, forestry 2, geology 2, meteorology 1, ornithology 1, pathology 1, psychology 2, physics 2, physiology 2. The average attendance at the meetings was about fifty, but more than one hundred were present to hear the paper by William R. Amberson, of Memphis, on "Haemoglobin-Ringer, a New Substitute for Blood in Mammals," which was illustrated with motion pictures.

Dr. A. Richard Bliss, director of the Reelfoot Lake Biological Station, made a report on investigations at the station last summer. Secretary McGill made a report which showed a decrease of 10.6 per cent. in the membership of the academy since 1931 and an increase of more than 100 per cent. in the number of members that are fellows of the American Association for the Advancement of Science.

On Friday evening, Dr. Otto Struve, director of the Yerkes Observatory of the University of Chicago; Mrs. Struve and the president of the Barnard societies of Chattanooga and Knoxville were the guests at the academy dinner at 6 P. M. in the Andrew Jackson Hotel. At 8 P. M. Dr. Struve delivered the academy address in the auditorium of the War Memorial Building on the subject, "Modern Conceptions of the Universe."

The officers of the academy elected for the year 1935 are:

George M. Hall, professor of geology, University of Tennessee, Knoxville, *President;* Dr. William Litterer, Tennessee state bacteriologist, Nashville, *Vice-President;* John T. McGill, professor of organic chemistry, emeritus, Vanderbilt University, Nashville, *Secretary-Treasurer;* Jesse M. Shaver, professor of biology, George Peabody College, Nashville, *Editor of the Journal;* Miss Eleanor Eggleston, assistant librarian, Vanderbilt University, Nashville, *Librarian.*

JOHN T. MCGILL,
Secretary

THE SECOND QUADRENNIAL CONGRESS OF THE MATHEMATICIANS OF THE SLAV COUNTRIES

LAST summer there took place in Europe four quadrennial regional mathematical congresses—in Leningrad (end of June), Stockholm (mid-August), Athens (early September) and the congress of the Slav countries in Prague (September 23–28). The undersigned had the opportunity of attending the first and fourth, the last as delegate of the National Academy of Sciences. The strongest impression received was regarding the seriousness of the consequences of increasing governmental interference in all domains, science not excluded. Thus, for various political reasons, a num-

ber of the closest neighbors of Czechoslovakia had hardly any representatives at Prague. The organizing committee, and particularly its prime mover, Dr. M. Valouch, did their best to counteract this tendency and in so doing they had as good success as could be expected. There were a number of foreign delegates, and the congress had a strong international tinge. There were very pleasant social activities and numerous opportunities to get together scientifically and otherwise. The congress had eight sections devoted to the principal branches of mathematics with 111 individual communications. There were also a number of more extended lectures by E. Cech ("On Duality Theorems in Topology"), V. Jarnik ("On Geometrical Number Theory"), Sierpinski (Superpositions of Functions, this address being read by Professor Cech owing to the absence of the lecturer), Menger ("Metrical Geometry") and others.

The organizers of the congress can not be praised too highly for their endeavors. It is only through such meetings that one may hope to nullify to some extent the ever-growing scientific autarchy the world over, the most serious menace to science at the present time.

S. LEFSCHETZ

PRINCETON, N. J.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CULTIVATION OF ENDAMOEBA HISTOLYTICA IN ERLENMEYER FLASKS

WHEN large numbers of *Endamoeba histolytica* are needed in culture, either for the inoculation of a series of experimental animals or for the preparation of antigen for the complement fixation test, the use of test-tube cultures is both expensive and time-consuming. A single rich culture in a test-tube is sufficient for the inoculation of only one kitten, and in testing the degree of pathogenicity of a strain of *E. histolytica* it is advisable to use at least twenty kittens. In the preparation of antigen several hundred tubes of rich cultures are required. We have found that much labor and some expense can be saved by growing the amoebae in Erlenmeyer flasks.

Probably any of the accepted media for cultivating *E. histolytica* may be employed in this way. We have used the medium recommended by Dobell and Laidlaw[1] consisting of whole egg diluted with Ringer's solution, overlaid with horse serum diluted with six parts of Ringer's solution and enriched with sterile rice flour.[2] We have used 250 cc flasks for cultivating amoebae for our animal inoculations and have found that one flask provides approximately the same number of amoebae as twenty-five to thirty test-tubes of 25 cc capacity. In the preparation of antigen we have used 500 cc flasks and have found that twenty-five to thirty flasks provide as much antigen as 350 to 400 test-tubes.

In the test-tube containing slants of coagulated egg-Ringer medium the amoebae multiply only in the rice flour and bacterial sediment at the bottom of the slant, whereas in a flask they have the whole egg-Ringer surface at the bottom to multiply upon. Approximately 15 cc of egg-Ringer mixture are required in a 250 cc flask, and 25 cc in a 500 cc flask. This covers the bottom of the flask in a thin layer. The egg-Ringer is coagulated by placing the flasks in a pan of boiling water, in an Arnold sterilizer or in the autoclave heated by live steam without pressure. The flasks must be watched to avoid overheating, which causes the formation of bubbles. A smooth base is desirable in order to provide the best surface for growth. After coagulation the flasks are autoclaved and placed in the refrigerator until needed. The serum-Ringer and rice flour are added a few days before use, and are tested for sterility by incubating for at least forty-eight hours before inoculation. Approximately 75 to 85 cc of horse-serum-Ringer are required for a 250 cc flask and 125 to 150 cc for a 500 cc flask. This provides a depth of fluid over the egg-Ringer base of about seven eighths of an inch. Approximately 0.25 cc of sterile rice flour is added to each flask. For inoculation with *E. histolytica* approximately 1 cc of a rich culture is transferred to each flask. This will usually give excellent growth in 48 to 72 hours. As with test-tube cultures a flask occasionally fails to produce good growth for some unexplained reason, but the chance of failure is less with flasks than with test-tubes.

The advantages of the flask method of cultivation are a saving in time in preparation of media and washing of glassware, a saving in glassware and a saving in media. A 250 cc flask requires only one fifth as much egg-Ringer and only three fifths as much horse serum-Ringer as twenty-five test-tubes. Furthermore, the chance of contamination in handling fewer containers is greatly reduced, owing to the reduction in the number of transplants. Again the chances for cultural variations in individual tubes is eliminated when constant conditions are desired in the inoculation of a series of animals. There is also a considerable reduction in the amount of rice flour used, which is a distinct advantage in the preparation

[1] C. Dobell and P. P. Laidlaw, *Parasitology* 18: 283–318, 1926.

[2] L. R. Cleveland and J. Collier, *Amer. Jour. Hyg.* 12: 606–613, 1930.

of antigen, as it is desirable to wash the amoebae as free as possible from the solid constituents of the culture before extracting.

Test-tube cultures are, of course, more practical than flask cultures for simply maintaining strains of amoebae, since only a few tubes are required. They are also useful for seeding flasks when these are required.

William W. Frye
Henry E. Meleney
Vanderbilt University School of Medicine

ON THE REMOVAL OF OXYGEN FROM WATER BY CUT BRANCHES[1]

It is well known that rooted plants, in water, will remove the dissolved oxygen rapidly, under certain conditions, or not at all, under other conditions. Among the modifying environmental characters are the temperature of the water and the insolation of the shoot. Whether or not rootless shoots, or branches, with leaves, may behave in an analogous way does not appear to be known. The present note indicates that they have the capacity of removing oxygen at least, but whether the rate of such removal can be modified by the factors above mentioned remains to be shown.

In the experiments here summarized the cut ends of leafy branches of a few species of shrubs and trees were kept in distilled water for various lengths of time and the oxygen content of the water was determined at the beginning and at the end of the experimental periods. It was found, in every instance, that the oxygen content of the water was decreased. A similar result was obtained with cut flowers.

As to the effect of the external factors spoken of above, a few experiments appeared to indicate that the temperature of the water had little influence, as opposed to the results with plants having roots. It is possible, however, that the rate of oxygen removal is related to the intensity of the light to which the shoot is exposed. In four experiments, for example, with leafy branches of mulberry the rate of removal was greater during darkness than light.

W. A. Cannon
Edith A. Purer
Stanford University

SPECIAL ARTICLES

MEASUREMENT OF THE VELOCITY OF LIGHT IN A PARTIAL VACUUM[1]

The plan to measure the velocity of light in a vacuum was proposed in 1929 by the late A. A. Michelson, professor of physics at the University of Chicago and research associate of the Carnegie Institution of Washington. He obtained the funds for the project and lived to see the apparatus installed, but was unable to take part in the measurements, which were carried out by F. G. Pease, of the Mount Wilson Observatory of the Carnegie Institution of Washington, and F. Pearson, of the University of Chicago. The apparatus was installed at Irvine Ranch, near Santa Ana, California; observations were made at intervals during the period from February, 1931, to March, 1933. The method used was that of the rotating mirror, the mirror itself being a cylinder of glass, on the periphery of which 32 equally inclined and optically flat surfaces were ground and figured parallel to the axis. The cylinder was rotated about its axis at a speed such that a beam of light reflected by one surface and traveling a distance of 8 or 10 miles was received and reflected by the next succeeding face of the compound mirror. From the measured speed of rotation of the mirror and the length of path of the beam of light, the velocity of light was readily deduced. The mirror was driven by an airblast regulated by a sensitive, hand-controlled valve; its rotational speed was ascertained stroboscopically by bringing it into coincidence with the vibrations of an electrically driven tuning fork whose frequency was in turn determined stroboscopically by comparison with the period of a gravity pendulum swinging freely under reduced air pressure. The rate of the pendulum was ascertained by flash-box methods in terms of an accurate clock whose rate was determined by comparison with corrected radio time signals from Arlington. For the two optical path lengths of 8 and 10 miles the speeds of the mirror were 730 and 585 rotations per second, respectively. The apparatus was mounted in a tube one mile in length, consisting of 60-foot sections of corrugated steel pipe 36 inches in diameter joined with rubber sleeves, placed on trestles a foot above ground and evacuated to pressures ranging from ½ to 5 mm of mercury. Steel tanks were attached to the ends of the tube; in these the optical parts, consisting of a small diagonal flat, an image-forming concave mirror and two 22-inch optical flats, were installed. Light from an arc lamp, after passing through a collimating lens and slit, was reflected from the upper half of the rotating mirror through an optically plane window in the side of the tube, and after repeated reflections was imaged on one of the large flat mirrors. It was then returned over a path just below the entering path, received on the lower half of the rotating mirror and thence through a small diagonal prism into a micrometer eyepiece. The length of the path followed by the beam of light was ascertained by reference to a base established with extreme care by the U. S. Coast and Geodetic Survey by the side of the pipe line. The ends of the base consisted of two concrete piers with inserted bronze reference plates placed opposite to the 22-inch plane mirrors. Transfer of the positions of these mirrors to the

[1] The study was made with the aid of a grant from the Carnegie Institution of Washington.

[1] Read before the National Academy of Sciences, Cleveland, 1934.

reference plates of the base line was effected by means of an accurate steel straight edge placed in line with and parallel to the mirror faces. The remaining necessary distances between mirrors were measured by steel tapes. Allowance was made for window thickness and air distance from the window to the rotating mirror. The mean paths were 12,811.204 and 15,999.744 meters for the 8- and 10-mile paths, respectively. Fifty-six measures of the base line were made.

The results of the several series of observations are listed in Table I.

TABLE I

Series	Date	Number of determinations	Velocity of light	Average deviation
1- 54	1931—Feb. 19 to July 14	493	299,770	12
1- 56	1932—Mar. 3 to May 13	753.5	780	11
57–104	1932—May 13 to Aug. 4	742	771	9
105–179	1932—Dec. 3 to 1933, Feb. 27	897	775	11
		2,885.5	299,774	11

The simple mean of the 2,885.5 separate determinations gives for the velocity of light in vacuo 299,774 km/sec. The average deviation (A.D.) given in the table is that of a single series from the mean of the group. A plot of the weighted velocity readings with respect to time shows the following characteristics. The mean velocity for 1931 is 299,770 km/sec. The mean value for the series 14–25 is 299,746 km/sec. while the value for the remainder of the year lies close to 299,775 km/sec. The mean values for the first 56 series of measures for 1932 is 299,780 km/sec. and that for series 57–104, ending in August, 1932, and including approximately the same number of observations, is 299,771 km/sec. If the readings be taken in small groups and the means plotted, the curve through these points starts early in March at 299,784 km/sec., runs slightly above the axis until early in May and then drops to 299,768 km/sec. early in June. Several fluctuations appear in the curve at this time. The curve remains below the axis until observations stopped on August 4. The mean value for 1932–33 is 299,775 km/sec. The curve starts early in December at 299,785 km/sec., crosses the axis about January 1 and reaches a value of 299,765 km/sec. about January 15. It then gradually rises to 299,787 km/sec. late in February. When the velocities were first plotted, each evening's observations were taken as a unit. A curve freely drawn through these points resembled somewhat the tide curve of the water depths at the nearby coast at a lunitidal interval of 10 hours later. To check this apparent relationship sun-moon tide curves were drawn by the U. S. Coast and Geodetic Survey on their tide-predicting machine and careful comparisons were made of the various components of the tide curves with the velocities. The best correlation seemed to be one between velocity and the horizontal component of the tide force perpendicular to the tube, the velocities being high for a strong tide force pulling in a southeasterly direction and low for a northwesterly direction. The dispersion of readings, however, is great, and consequently little weight can be attached to this relation. The same may be said regarding a plot of velocities and moon diameters. Independent plots of both the early 1932 and the 1932–33 observations each show the same feature, namely, that the velocity is high when the diameter is either large or small, suggesting tidal effects. The scattering, however, is large and the results questionable. The formation of the weighted mean curve has, however, eliminated most of the apparent periodic fluctuations. Repeated measures of the base line and checks on the clock rate showed no changes capable of producing the residual differences between the mean curve and the axis. A vibration of the mirror system with a period equal to a fraction of that of the rotating mirror conceivably may have produced the rapid fluctuations observed in the individual readings.

THE LATE A. A. MICHELSON
F. G. PEASE
F. PEARSON

EXPERIMENTAL STIMULATION DEAFNESS

It has frequently been reported, and also denied, that prolonged exposure of animals to loud tones causes histological damage to the organ of Corti or loss of sensitivity to sounds as judged by conditioned reflexes. Recently the electrical responses of ear and auditory nerve have also been employed in this type of experiment as additional indicators of possible damage.[1] During the past two years, we have exposed five groups of animals (cats and guinea-pigs) to tones of 600, 800 or 2,500 c.p.s. and examined them by one or more of these methods. We believe that our results throw some light on the variability apparent in previous reports.

In testing auditory function of anesthetized animals by the electrical response, we pick up an electrical potential at the round window and observe the amplified electrical waves with a cathode ray oscillograph. The intensity of sound necessary to cause a just-visible deflection is taken as threshold. The sensitivity of normal cats and guinea-pigs determined by this method corresponds quite closely to the normal human audibility curve and is in excellent agreement with our own and with Horton's[2] determinations of the sensitivity of guinea-pigs by the method of conditioned reflexes. This justifies the use of the electrical method in testing auditory function.

1 E. G. Wever, C. W. Bray and G. P. Horton, "The Problem of Stimulation Deafness as Studied by Auditory Nerve Technique," SCIENCE, 80: 18–19, 1934.

2 G. P. Horton, "A Quantitative Study of Hearing in the Guinea Pig (Cavia Cobaya)," *Jour. Comp. Psychol.*, 15: 59–73, 1933.

A preliminary group of 3 cats and 3 guinea-pigs was exposed to 600 c.p.s. at 85 db above human threshold for durations up to 2 months. They were tested electrically, and the guinea-pig ears were examined histologically. None of them showed significant deviations from normal or recognizable histological lesions.

A second group of 5 guinea-pigs was exposed to 800 c.p.s. at 95 db for 16 hours a day for durations up to 74 days. All these animals were equally normal by electrical test.

A third group of 13 normal guinea-pigs was exposed to 600 c.p.s., 9 at 65 db and 4 at 95 db for 70 and 75 days, respectively. They were tested by the conditioned-reflex method (Kemp[3]) at frequencies 400, 500, 600, 700 and 800 c.p.s. before and after exposure. One of the first 9 and all the second 4 animals showed slight losses of sensitivity amounting to not more than 20 db at most in this range. The other 8 remained normal. The animal most affected showed by the electrical method an average deficiency of 12 db over the entire range from 15 to 1,500 c.p.s., but was practically normal from 1,750 to 10,000 c.p.s. There was no specific loss at or near 600 c.p.s. Histological examination of this ear revealed degenerate external hair-cells in the organ of Corti scattered through the second, third and fourth turns. In no region were more than 25 per cent. of the cells abnormal.

Seven guinea-pigs, 3 exposed to a d_4 whistle (about 2,400 c.p.s.) at 97 db for 15 hours a day for 40 days and 4 to 2,500 c.p.s. at 106 db for 45 days, all showed loss of sensitivity electrically and degeneration of external hair-cells histologically. Three of the most severe cases showed maximal losses of 76 db, 52 db and 50 db, and also distortions of wave form in the response. The zone of greatest loss lay in each case between 1,200 and 1,800 c.p.s. Two of these animals on histological examination each showed in both ears extensive degeneration of external hair-cells and also a rupture of Reissner's membrane in the second and third turns. The animal with greatest loss showed similar degeneration of cells and also hemorrhage into the scala media. The remaining 4 guinea-pigs showed losses of sensitivity, varying in degree from 20 to 56 db, in the range from 750 c.p.s. to 1,500 c.p.s. In the mildest case the loss involved only this range, while in the most severe the entire range tested (60 to 10,000 c.p.s.) was involved. The loss in the latter case averaged 37 db from 70 to 250 c.p.s., 52 db from 375 to 1,500 c.p.s., 40 db from 1,750 to 5,000 c.p.s., and 20 db from 6,000 to 12,000 c.p.s. The other 2 were intermediate in degree, but essentially similar in type. Histologically all showed more or less severe degeneration of external hair-cells in a wider or narrower zone of the organ of Corti, centering in each case in the middle third of the second turn of the cochlea. The severity and extent of the lesion correlated closely with the degree and extent of abnormality of the audiogram. The transition from normal to abnormal was gradual, both in the audiogram and in the histological picture.

[3] E. H. Kemp. In press.

These results indicate that the frequency as well as the intensity of the exposure tone may be an important factor in determining whether or not the inner ear is damaged. Considerable individual differences in susceptibility are also indicated. Intense exposure may apparently cause extensive loss of hearing, although we have not yet encountered the type of extreme loss affecting the entire range equally, as described by Finch and Culler.[4] The gross internal damage to the inner ear in some of our cases shows that interpretation is impossible without proper histological examination. In experiments now in progress we hope to extend the correlation of losses shown by the electrical method with loss of response by the method of conditioned reflexes. It is somewhat surprising and difficult of explanation that the zone of greatest loss of sensitivity as determined electrically does not necessarily coincide in frequency with the exposure tone. The losses and also the pathological lesions are wide-spread, indicating that the resonance of the basilar membrane is not sharp, but the more favorable cases of moderate damage support the "place" theory of pitch perception and relate the frequency 1,200 c.p.s. with the middle of the second cochlear turn in the guinea-pig. This is approximately the middle of the audible range and also approximately the middle of the basilar membrane.

HALLOWELL DAVIS
ARTHUR J. DERBYSHIRE
EDWARD H. KEMP
MOSES H. LURIE
MORGAN UPTON

HARVARD UNIVERSITY AND
CLARK UNIVERSITY

[4] G. Finch and E. Culler, "Effects of Protracted Exposure to a Loud Tone," SCIENCE, 80: 41–42, 1934.

BOOKS RECEIVED

ALLEN, ARTHUR A. *American Bird Biographies.* Pp. ix + 238. 20 plates. 189 figures. Comstock. $3.50.

Anales del Museo Argentino de Ciencias Naturales, "Bernardino Rivadavia." Tomo XXXVII. Pp. xiv + 581. Illustrated. Museo Nacional de Historia Natural, Buenos Aires.

KRAUSE, ARLINGTON C. *The Biochemistry of the Eye.* Pp. xv + 264. 17 figures. Johns Hopkins Press. $3.25.

LUTZ, FRANK E. *Field Book of Insects.* Pp. 510. 800 illustrations. Putnam's. $3.50.

PENDRAY, G. EDWARD. *Men, Mirrors and Stars.* Pp. x + 339. 31 plates. 47 figures. Funk and Wagnalls. $3.00.

SPECIAL ISSUE CONTAINING REPORTS OF THE THIRD PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

SCIENCE

VOL. 81 FRIDAY, FEBRUARY 1, 1935 No. 2092

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster, Pa Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

Edited by Dr HENRY B WARD

PERMANENT SECRETARY

GENERAL FEATURES

THE third Pittsburgh meeting closed on New Year's day with a record of events which made the occasion worthy of rank alongside of the earlier meetings in that city as marked dates in the history of the association The first meeting in Pittsburgh was held in June, 1902 From 1848 to that date the association had held fifty meetings in summer But the vision of larger opportunities for the advancement of science brought leaders in the organization to undertake a radical change The period in midwinter designated Convocation Week was fixed upon as better adapted to bring together all college workers in science and those in outside activities That Pittsburgh meeting voted to start the new plan by convening again in Washington in December, the first time also that two meetings had been held in the same twelve months Then began also the movement to associate with the meetings technical societies in the various fields of science (of which two were accepted for that first Pittsburgh meeting) with opportunities for joint programs, discussions and stimulating personal contacts. The second Pittsburgh meeting in December, 1918, was a conference of leaders in science with a planned program definitely related to preparedness that placed science at the service of the nation

The meeting just held demonstrated in a striking manner the effect of the plan adopted at Pittsburgh in 1902 Then the entire registration was recorded as 437[1] in ten sections and two affiliated societies, most

[1] "which placed the meeting far up toward the head of the list so far as this feature is to be taken into account." L. O Howard, Proc 51 (1902 547)

recently from four to five thousand society members, visitors and citizens took part in the meetings of fifteen sections and forty-two associated organizations, while several times that number had at the exhibition a glimpse of apparatus, literature and research in science. The evidence of growth and advance in commerce and industry in Pittsburgh itself were not more impressive than those in the power and influence of the association when one compared 1934 with 1902.

Pittsburgh provided ample and attractive facilities for the meeting in the unusual group of buildings centering around the Carnegie Institute and the University of Pittsburgh. Rarely can such accommodations be secured within easy access of each other. The beautiful Carnegie Music Hall, provided for general sessions by the courtesy of the trustees of the Carnegie Institute through Colonel Samuel Harden Church, the Carnegie Museum and Library, the well-equipped lecture rooms and laboratories of Carnegie Tech and the remarkable even though still unfinished Cathedral of Learning of the University of Pittsburgh, together with auditoriums in the nearby buildings of the Bureau of Mines, the Board of Education, the Y. M. H. A., the Western Penn Historical Society, the other cooperating educational institutions and prominently the Mellon Institute of Industrial Research all together gave a wealth of meeting places such as the association and affiliated societies rarely enjoy.

To the local committee must be assigned all credit for providing arrangements so perfect in detail that the large series of meetings was run off without friction or delay. The chairman, President Thomas S. Baker, of the Carnegie Institute of Technology, at an early date laid careful plans that insured the ultimate success of the affair and his enforced absence later owing to ill health was deeply regretted by all. Coming into the work at a late date the vice-chairman, Dr. Davenport Hooker, of the University of Pittsburgh, did yeoman service in completing the arrangements. In this he was ably assisted by E. K. Collins, secretary of the local committee, and others. Especial mention should be made of Lawrence H. Miller, whose extremely efficient work in making room assignments and providing all the apparatus and helpers demanded by many societies and speakers in a hundred separate places relieved the permanent secretary's staff of a trying task. W. N. James, who took charge of local publicity, did fine work both for the meetings and for the local press. But the general satisfaction voiced on every hand showed that many others than those mentioned above were actively participating in making the occasion successful in all its aspects.

The registration at Pittsburgh reached 2,823, which was the largest total attained in several years. It was also widely distributed. Pittsburgh contributed 381 of the number and other points in Pennsylvania added 387. From New York 390 were registered, from the District of Columbia 139, from New Jersey 107, from Maryland 87 and Delaware 9. New England furnished 131 from Massachusetts, 61 from Connecticut, 16 from Rhode Island, 13 from New Hampshire, 9 from Maine and 2 from Vermont. Among the Central States Ohio registered 235, Illinois 160, Michigan 126, Wisconsin 62, Indiana 56, Iowa 42, Minnesota 40, Missouri 37. From the Southern States West Virginia sent 52, Virginia 47, Tennessee 21, North Carolina 19, Kentucky 15, Louisiana 11, Georgia 10, Alabama and Mississippi 5 each, South Carolina and Florida 4 each. Out of the plains and mountains Kansas, Colorado and Texas brought 9 each, Nebraska 7, Arkansas 6, Oklahoma and Utah 5 each, Montana 3, Wyoming and North Dakota 2 each, South Dakota, Arizona and New Mexico 1 each. The Pacific Coast was represented by California 20 and Washington 4. Only the states of Idaho, Oregon and Nevada were unrepresented. From Canada 29 were registered, from Hawaii 4, from Mexico 3, from Puerto Rico 2, and from other foreign countries 17, namely, 2 each from England, Germany, Italy and Scotland, and one each from Belgium, Brazil, China, France, Greece, Holland, Japan, Switzerland and Syria. This record shows clearly the range of interest in the meeting and of participants in its program.

Only two delegates from abroad registered at Pittsburgh, Professor H. B. Fantham and Mrs. Fantham (Dr. Annie Porter), now of the department of zoology at McGill University, were present as delegates from the Royal Society of South Africa and the South African Association for the Advancement of Science.

The General Program, which as usual was compiled and edited by Sam Woodley, executive assistant, with the aid of the local committee, has been effectively reorganized in order to decrease its size without loss of value. The amount of material this year was in fact large, as all sections of the association were active, the three conferences held sessions and forty-two societies contributed strong programs. These items, together with general sessions, special lectures and much other material, are well presented in the printed program. The most important features are referred to specifically later in this report. The Pittsburgh edition of the program was generally commended. Members may receive copies of the book by addressing the office of the permanent secretary, Smithsonian Institution Building, Washington, D. C.

Professor Edward L. Thorndike, of Columbia University, was president for the Pittsburgh meeting and contributed notably to its program. He presided at the opening general session, which was held on Thurs-

day evening in the Carnegie Music Hall. Other officers of the association and representatives of the local committee and cooperating educational institutions were seated on the stage. To the large audience assembled President Thorndike introduced first Dr. Samuel Black Linhart, secretary of the University of Pittsburgh, and then Colonel Samuel Harden Church, president of the Carnegie Institute, both of whom graciously welcomed the association and affiliated societies in behalf of the city and its educational institutions. President Thorndike responded happily to the addresses of welcome and then brought before the meeting the amendment to Article 2 of the constitution passed by the council as shown in the record below. The amendment was unanimously approved.

Dr. Wm. Alanson White, the speaker of the evening, was then introduced by President Thorndike. The address on "Man, the Great Integrator" was illustrated by examples from the field of psychiatry showing the reciprocal relation of the world within and the world without; it demonstrated how psychiatry, like general science, has discarded many of the older traditional ways of thinking and as a result has discovered a new world of thought and knowledge of great significance to the understanding of man and to culture in general.

The Sigma Xi address at the general session on Friday evening in Carnegie Music Hall was delivered by Professor E. A. Hooton, of Harvard University; his subject was "Homo Sapiens, Whence and Whither." On Monday evening the address of the retiring president of the association was given by Professor Henry Norris Russell, of Princeton University, on "The Atmospheres of the Planets." The addresses of the retiring vice-presidents which attracted appreciative audiences are all recorded in the accounts of the sections of which they were presiding officers.

A series of special invited lectures was listed for late afternoon hours. On Thursday Professor Wm. H. Hobbs, of Michigan, spoke on "The Career of Admiral Peary, the Discoverer of the North Pole," an appropriate event to mark the quarter-centennial of the discovery. On Friday, an illustrated lecture on the subject "Twins Reared Apart and the Nature-Nurture Problem" was delivered by Professor H. H. Newman, of the University of Chicago. The same day Professor Albert Einstein gave the Josiah Willard Gibbs lecture before the American Mathematical Society and guests. His subject was "An Elementary Proof of the Theorem Concerning the Equivalence of Mass and Energy." The lecture attracted wide-spread attention.

Other important events included an illustrated lecture on Friday afternoon by W. R. Chapline, of the U. S. Forest Service, on "Forestry Fosters New Approach to Watershed Conservation," and a demonstration lecture on Saturday afternoon by Dr. Mark H. Liddell, emeritus of Purdue University, on "The Acoustics of the Auditory Spectrum," with experiments by Dr. C. T. Knipp, of the University of Illinois, with the Knipp singing tubes. On Sunday afternoon Dr. Phillips Thomas, of the Research Department of the Westinghouse Company, gave a demonstration lecture on "Ramblings in Research." It was truly a remarkable and vivid series of physical experiments, which included recent discoveries not previously presented publicly, but unfortunately the audience was small though highly appreciative.

Among the special courtesies extended locally to the association and associated societies first mention must be made of the complimentary concert on Sunday evening. It was an organ recital by Dr. Marshall Bidwell in Carnegie Music Hall and was a treat to all lovers of music. He was assisted in the program by the symphony orchestra of the Carnegie Institute of Technology, directed by Professor J. Vick O'Brien, head of the department of music. About eighty musicians compose this orchestra, which is a non-professional ensemble of high repute. The general reception tendered the officers and members of the association and guests was held in the foyer of the Music Hall on Thursday evening after the general session and was greatly enjoyed. Numerous other social events, some planned especially for visiting ladies, were carried out with a spirit of generous hospitality that won the fullest appreciation of those in attendance, but space is lacking to give specific mention to all that was done for visitors during the meetings in Pittsburgh.

NEWLY ELECTED OFFICERS OF THE ASSOCIATION

At Pittsburgh the council elected the officers, whose names are listed below, for the year 1935 or such other term as is indicated in the particular case. This list has already been published in SCIENCE for January 4, 1935.

President, Karl T. Compton, Massachusetts Institute of Technology.

General Secretary, Otis W. Caldwell, Teachers College, Columbia University.

Vice-presidents and chairmen of sections:

Mathematics (A), T. H. Hildebrandt, University of Michigan.

Physics (B), John T. Tate, University of Minnesota.

Chemistry (C), Moses Gomberg, University of Michigan.

Astronomy (D), H. R. Morgan, U. S. Naval Observatory.

Geology and Geography (E), Walter E. McCourt, Washington University.

Zoological Sciences (F), Oscar Riddle, Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Botanical Sciences (*G*), E. W. Sinnott, Columbia University.
Anthropology (*H*), N. C. Nelson, American Museum of Natural History, New York, N. Y.
Psychology (*I*), Joseph Peterson, George Peabody College for Teachers, Nashville, Tenn.
Social and Economic Sciences (*K*), Shelby Harrison, Russell Sage Foundation, New York, N. Y.
Historical and Philological Sciences (*L*), George Sarton, Harvard University Library.
Engineering (*M*), H. N. Davis, Stevens Institute of Technology, Hoboken, N. J.
Medical Sciences (*N*), Stanhope Bayne-Jones, Yale University Medical School.
Agriculture (*O*), H. K. Hayes, University of Minnesota.
Education (*Q*), F. B. Knight, University of Iowa.

Elected members of the council (for term ending 1938):
Louis B. Wilson, Mayo Foundation, Rochester, Minn.
W. F. Ogburn, University of Chicago.

Members of the executive committee:
J. McKeen Cattell, Garrison, N. Y. (for term ending 1938).
Burton E. Livingston, Johns Hopkins University (for term ending 1938).
E. B. McKinley, George Washington University Medical School (for term ending 1937).

Trustee of Science Service (for term ending April, 1938):
Henry B. Ward, Washington, D. C.

Members of the Committee on Grants (for term ending 1938):
Roger Adams, University of Illinois.
McKeen Cattell, Cornell University Medical College.

Member of Finance Committee (for term ending 1938):
Herbert Gill, Washington, D. C.

Member of the Division of Foreign Relations of the National Research Council:
W. A. Noyes, University of Illinois (for term ending 1937).

KARL TAYLOR COMPTON—PRESIDENT-ELECT OF THE ASSOCIATION

(*By Professor Edwin B. Wilson*)

KARL TAYLOR COMPTON, elected president of the American Association for the Advancement of Science, is a member of a notable family. His father, Elias Compton, was professor of philosophy at Wooster College and dean of the college, throughout the formative period of the son. One brother, Arthur, is Nobel laureate in physics, and another, Wilson, is a leader of the National Lumber Manufacturers Association. Genetic and environmental influences alike conspired to bring our new president early into prominence and effectiveness in science, in academic administration and in public affairs.

Dr. Compton received his doctorate at Princeton in 1912 and, after teaching for three years at Reed College in Oregon, went to Princeton as assistant professor of physics, where he was advanced to a professorship, and later to a research professorship and chairmanship of the department of physics. He left Princeton in 1930 to become president of the Massachusetts Institute of Technology, where he has already markedly developed the research activities and in particular has rapidly built up an excellent department of physics. Despite his administrative problems he has had the energy and has found the time to cooperate and even to lead extra-mural activities of public importance to science. He was one of the organizers of the American Institute of Physics, he served as a member of the Massachusetts commission for the stabilization of employment. He has long been a valued member of the executive committee of this association and recently has been chairman of the Science Advisory Board, appointed by President Roosevelt to bring the advice of some of our scientific leaders to bear upon problems of great importance to the government in its scientific work.

It is, however, of Dr. Compton as a scientist that we wish particularly to speak at this time. His early work was in the photoelectric effect; in the early days of the rapid development of this subject, he wrote pioneering contributions which led up to the determination of Planck's constant h by this means and to a check of Einstein's photoelectric law. Later he concentrated on the theory of ionization by collision and with his brother Arthur developed a famous new instrument of research, the Compton electrometer.

The years following the war saw a tremendous growth in interest in the determination of the critical potentials of atoms and molecules, and one of the most prominent schools at work in this field was that of Compton at Princeton. He not only worked in his own name, even more he gave generously of his time and advice in the work of others. No list of his papers appearing at that time or subsequently would give an adequate idea of his influence upon the subject; he knew how to work through others, and they liked to work with him.

Out of these studies of critical potentials came a series of papers on electric discharge in gases and on dielectric constants. Interested in everything which pertained to the electron and its ways with atoms, Dr. Compton in 1926 embarked on a program of researches in vacuum spectroscopy. His principal contributions to spectroscopy, in addition to his design and contribution with J. C. Boyce of the first vacuum spectrograph of sufficiently broad range to cover the whole extreme ultra-violet at a single setting and with relatively high dispersion, were his analyses of the lines Ne II and Ne I. The second of these was particularly timely, as it gave a quantitative basis to the explanation of "active" nitrogen.

A scientist may make great contributions by the discovery of new facts, by the invention of new instruments, by the theoretical or mathematic treatment of phenomena, by helpful suggestiveness to his students and colleagues, or by administrative vision in setting up constellations of personnel and problems. The key to an appreciation of Compton's importance in American science to-day is in the even balance at a high level that he has maintained among all these types of contribution, and in the range of his interest and understanding beyond his chosen field of physics. Elected president at an exceptionally early age, he will bring to the office a full maturity for service in these troubled times.

THE ASSOCIATION PRIZE

A generous friend has provided one thousand dollars annually for the last dozen years to be awarded each year to the author of a noteworthy paper on the program of the winter meeting. It is the desire of the donor, who wishes to remain unknown, that the award might serve to strengthen the program and stimulate younger men to contribute their best work to it rather than to bestow added honors upon older workers. The committtee on prize award is not charged to do more than to select *an outstanding paper*. Its work was done this year with great thoroughness and met with general approval.

VERN OLIVER KNUDSEN—TWELFTH ASSOCIATION PRIZEMAN

The association prize of this year was awarded to Dr. V. O. Knudsen, associate professor of physics, University of California at Los Angeles, for his contribution on "The Absorption of Sound in Gases." This paper was delivered on Saturday afternoon, December 29, at a joint session of The American Physical Society and The Acoustical Society of America, meeting under the Section on Physics of the American Association. In his opening sentence Dr. Knudsen said, "The measurement of the velocity and absorption of sound in gases provides a new technique for investigating molecular collisions." He presented experimental and theoretical arguments supporting this statement and recounted new and immediately practical discoveries on the influence of humidity, gas mixture and air temperature on the absorption of high frequency sound waves. The paper won wide recognition as an outstanding contribution both in pure and applied physics.

The science of sound is not a new or transitory interest with Dr. Knudsen, for in this general field he has worked with distinction during nearly fifteen years. Tuning forks, organ pipes and vibrating string constituted essential equipment in the older sound-physics but gave place rather recently to the vacuum tube oscillator. As a graduate student in physics, Knudsen arrived on the scientific scene synchronously with this new development in sound-producing and measuring apparatus. His doctor's dissertation, worked out in the Ryerson Physical Laboratory, University of Chicago, in 1922, was entitled, "The Sensibility of the Ear to Small Differences of Intensity and Frequency." As a source of sound in this study he used a telephone receiver actuated by energy from a vacuum tube oscillator, capable of producing any desired frequency between 30 d. v. and 20,000 d. v. with intensity variable and measurable from extreme (painful) loudness to that which was below audibility. With this new, flexible method improved solutions were found for some of the problems which had interested physicists, physiologists, psychologists and musicians for a half century. But this was only the beginning! His researches on sound have spread almost as sound itself propagates, that is, in all directions. He has studied reverberation and the interfering effects of tones and noises upon speech reception, the problems of the hard-of-hearing, the relationships between hearing and the sense of touch, the nature of speech and many related topics.

The work which has introduced Dr. Knudsen most widely to the scientific, engineering and general public is his substantial text on *"Architectural Acoustics,"* published in 1932. In this volume he has brought together comprehensive statements for many of his own research results and has reviewed the fundamental principles and data on reverberation of sound, absorption, sound insulation and acoustics. Here he applies his research results to the problems presented by many types of buildings, including radio broadcast and sound-recording studios. He has made material scientific advance in solving many of the difficult problems which have arisen in connection with the building of "sound stages" necessary for the success of the modern motion picture.

Dr. Knudsen was born in Provo, Utah, in 1893. After graduating from college in 1915 he worked in the research laboratories of the Western Electric Company, New York City, during 1918 and 1919. He was assistant in physics at the University of Chicago from 1920 to 1922. After receiving the doctorate in physics in 1922, he was appointed assistant professor at the University of California at Los Angeles, was promoted to the rank of associate professor in 1927 and became chairman of the department in 1932. During the current year he has held the high honor of being the president of the Acoustical Society of America.

SPECIAL COUNCIL ACTION

A report on the organization of local branches, which had been presented by the executive committee and discussed in the Academy Conference, was ap-

proved unanimously. The request for such a branch at Lancaster, Pa., was on recommendation of the executive committee granted.

By vote of the council and confirmatory action by the general session, Article 2, line 4, of the constitution was amended by omitting the words, "The admission fee for members is five dollars; the annual dues are five dollars" and adding in this place "The council shall fix the admission fees and dues."

Later the council voted that "The annual dues shall be $5.00 and the admission fee shall also be $5.00, but no admission fee shall be required from members of affiliated societies and affiliated academies. The admission fee may also be waived under such other special circumstances as may be approved by the council."

Under the terms of the Jane M. Smith Fund the following were elected emeritus life members: Charles Sumner Tainter (F81), Francis H. Williams (F90) and Karl Langenbeck (F96).

From the income of the Luella Owen Fund the following were elected emeritus annual members: Beverly T. Galloway (M88F90), Clarence P. Gillette (M01F01) and John Lane Van Ornum (M01F04).

The resignation of Dr. Burton E. Livington as general secretary was accepted with deep regret and the council expressed its appreciation of his long and able services as permanent secretary and later as general secretary.

The following minute regarding the Pittsburgh meetings was ordered spread on the records and transmitted to the persons concerned:

The council of the A. A. A. S., reviewing the records of this the third Pittsburgh meeting of the association which is just drawing to a close, is impressed by the results which have been achieved. Members representing all sections of the association and more than fifty of its associated organizations in special fields, coming from all parts of our country and requiring diverse conditions for successful presentation of research work in technical lines, have been well provided for in every respect. For generous hospitality and thoughtful provision in many ways the association is deeply indebted and desires in this minute to record its thanks to the city of Pittsburgh, to the Carnegie Institute of Technology, the University of Pittsburgh, the Pennsylvania College for Women, Duquesne University and the Carnegie Institute and to the other agencies which have so graciously contributed to make the meetings a success. Especial thanks are due to the officers and members of the local committee, to Dr. Thomas S. Baker, president of the Carnegie Institute of Technology, as chairman, and Dr. Davenport Hooker, of the University of Pittsburgh, as vice-chairman, and others who gave such valuable personal service in planning and carrying out the work connected with the preparation and handling of the meeting.

To the director of the Mellon Institute of Industrial Research and his associates we owe much of the success of the largest and best scientific exhibition which the association has yet held and which was possible only because of the space in the splendid new building of the Mellon Institute surrendered for this purpose and of the work of Dr. L. O. Grondahl and his special local committee. Members of the association enjoyed greatly the complimentary concert tendered to them by Dr. Marshall Bidwell, director of the Carnegie Music Hall, and Professor T. Vick O'Brien and the symphony orchestra of the department of music.

FINANCIAL REPORTS

The financial reports and budgets of the treasurer and permanent secretary as audited were presented, discussed and approved. They are printed below.

OFFICE OF THE TREASURER

BALANCE SHEET

September 30, 1934

Assets

Investments		
Securities		$237,475.01
Cash		
Income account	$8,206.36	
Reserve for current needs	13,000.09	21,207.05
		$258,682.06

Liabilities

Endowment and Other Funds	Research	General	
W. Hudson Stephens		$4,381.21	
Richard T. Colburn	$85,586.45		
Michael P. Rich		10,000.00	
Hector E. Maiben		31,448.17	
Friends of the Association		3,559.00	
Fees of Sustaining Members			
Living		1,000.00	
Deceased	6,000.00		
Fees of Life Members			
Living		39,850.00	
Deceased	13,750.00		
	$105,336.45	$90,238.38	$195,574.83
Jane M. Smith:			
Original amount		$5,000.00	
Fees of Deceased Emeritus Life Members		3,100.00	8,100.00
Luella A. Owen			500.00
Reserve Fund			25,149.19
Emergency Reserve Fund			16,357.35
Prize Fund			4,000.00
			$249,681.37
Accumulated Income Unappropriated			
Endowment and other funds			
Research	$4,620.11		
General	3,965.52	$8,594.63	
Jane M. Smith		383.16	
Luella A. Owen		22.00	9,000.69
			$258,683.06

CASH STATEMENT

October 1, 1933, to September 30, 1934

Receipts

Balance from last report (September 30, 1933)			$19,887.56
Prize fund		$2,000.00	
Life-membership fees		800.00	
Curtailment on mortgages:			
Ben Maiben	$2,500.00		
H. L. Scattergood	750.00	3,250.00	
Interest on investments		10,710.71	
Purchased interest on bonds		168.61	16,929.32
			$36,816.88

Disbursements

Investments:		
$5,000 U. S. Treasury 4s, 1954	$5,184.38	
$5,000 Consolidated Gas Co. of N. Y. 5s, 1957	4,802.80	
	$9,987.18	
Interest purchased	168.61	$10,155.79

Grants allotted by Council:		
Union of American Biological Societies	$400.00	
Mt. Desert Laboratory	100.00	
Concilium Bibliographicum	100.00	
American Mathematical Society	100.00	
F. C. Brackett	500.00	
B. M. Duggar	420.00	
J. C. Stearns	250.00	1,870.00
Prize fund, R. L. Kahn		1,000.00
Jane M. Smith, three Emeritus Life Memberships		300.00
Hector E. Maiben lectures		703.68
Life-membership subscriptions for SCIENCE		1,536.00
Safe deposit box, collection charge and U. S. tax on checks		29.36
Luella A. Owen, three Emeritus Annual Memberships		15.00
		$15,609.83
Cash on hand		21,207.05
		$36,816.88

OFFICE OF THE PERMANENT SECRETARY

RECEIPTS AND DISBURSEMENTS FOR THE FISCAL YEAR 1933–34

(October 1, 1933, to September 30, 1934)

Receipts

To balance from last account:		
Publication fund	$4,280.88	
Available for general purposes	5,726.09	
Emergency fund	5,000.00	
Special fund for Committee on Place of Science in Education	1,903.03	
Special fund for Committee on Popular Science Reading Lists	2,131.76	$19,041.76
Membership dues and fees:		
Annual dues, previous to 1933	$80.00	
Annual dues for 1933	1,541.00	
Annual dues for 1934	79,274.79	
Advance payments for dues, etc.	951.50	
Entrance fees	145.00	
Life-membership fees	800.00	82,792.29
From Treasurer for Maiben lectures		703.68
Other general receipts:		
Life-membership journal subscriptions (from Treasurer)	$1,536.00	
Interest on bank accounts	1,114.68	
Sales of Proceedings volumes	7,269.50	
Sales of Booklists	7.50	
Sales of Marburg lecture (American Society for Testing Materials)	64.50	
Sales of Stabilization of Employment	15.00	
Overpayments	39.15	
Miscellaneous receipts	85.30	10,131.63
Special journal subscriptions:		
SCIENCE and *Scientific Monthly*	$2,043.00	
Science News Letter	399.00	2,442.00
Boston Meeting:		
Registration fees	$2,254.75	
Exhibition-Receipts from exhibitors	2,844.74	
From local committee (unexpended balance of local funds)	171.57	5,271.06
Berkeley Meeting:		
Registration fees		1,142.00
Pittsburgh Meeting:		
Exhibition-receipts from exhibitors		825.00
Receipts from other meetings:		
Atlantic City exhibition		40.00
		$122,389.42

Disbursements

Subscriptions to official journals, including foreign postage			$50,115.88
Division and Academy allowances:			
Divisions		$2,133.00	
Affiliated academies		1,482.50	3,615.50
Expenses of Washington Office:			
Salaries		$15,789.85	
Office and addressograph supplies		431.50	
Printing and stationery		1,097.75	
Telephone and telegraph		192.62	
Postage		1,596.99	
Exchange		31.65	
Express, freight, and drayage		29.08	
Office furniture and equipment		217.50	
Miscellaneous expense		265.07	19,652.01
Expenses of General Secretary's office			27.92
Expenses of Treasurer's office			200.00
Circularization, inviting new members			2,923.02
Miscellaneous expenditures:			
Life-membership fees to Treasurer		$800.00	
Refunds of overpayments		39.15	
Boston Meeting:			
General expenses	$2,631.08		
Maiben lecture	403.68		
Travel expenses, Executive Committee	506.96		
Travel expenses, Section Secretaries	914.04		
Miscellaneous expenses, Section Secretaries	725.45		
Exhibition	1,671.45		
Press Service	496.15	7,348.81	
Berkeley Meeting:			
General expenses	$2,112.16		
Maiben lecture	300.00		
Travel expenses, Executive Committee	536.76		
Travel expenses, Section Secretaries	414.10		
Miscellaneous expenses, Section Secretaries	210.32		
Press Service	372.08	3,945.42	
Pittsburgh Meeting:			
General expenses	$140.68		
Exhibition	1,362.86	1,503.54	
Atlantic City Meeting		7.33	
Chicago Meeting		30.00	13,674.25
Miscellaneous travel expenses			1,111.23
Preliminary expenses on Proceedings Volume			4,027.62
Expenses of Committee on Place of Science in Education			206.48
Expenses of Committee on Popular Science Reading Lists			413.19
Special journal subscriptions:			
SCIENCE and *Scientific Monthly*		$2,064.00	
Science News Letter		399.00	2,463.00
American Society for Testing Materials (Sales of Marburg lecture)			64.50
			$98,494.60
By new cash balances:			
Publication fund		$7,522.76	
Available for general purposes		7,949.44	
Emergency fund		5,000.00	
Special fund for Committee on Place of Science in Education		1,696.55	
Special fund for Committee on Popular Science Reading Lists		1,726.07	23,894.82
			$122,389.42

Cash in banks:	
American Security and Trust Co. (Checking)	$ 1,024.72
American Security and Trust Co. (*Savings*)	3,440.89
Riggs National Bank (Savings)	3,071.86
Reserve held by Treasurer	16,357.35
	$ 23,894.82

The accounts of the treasurer and permanent secretary were audited under the direction of Dr. W. J. Humphreys, official auditor of the association. Complete financial reports and accompanying papers are on file and copies are available if desired.

MEMBERSHIP

The following table shows the status of membership on September 30 of 1933 and 1934:

	Sept. 30, 1933	Sept. 30, 1934
Sustaining members	1	1
Life members	511	501
Annual members, paid-up	15,216	15,927
Total in good standing	15,728	16,429
Members in arrears for one year	1,044	932
Members in arrears for two years	1,177	1,192
Total enrolment	18,549	18,553

During the fiscal year 1934, 2,029 members were added to the membership list, while 2,025 were removed on account of resignations and deaths.

Since October 1, 1934, 717 names have been added to the roll, while 1,438 have been removed, making the total enrolment on January 10, 1935, 17,832.

THE THREE CONFERENCES

The Academy Conference, following the plan of past years, met at 11:00 o'clock on Thursday, continued through luncheon and thereafter. Discussions took up problems of financial support from the association, high-school science clubs and the junior academy movement, greater activity in the development of projects of mutual interest, and the proper relations to academies for local branches of the association.

The Secretaries' Conference was held on Sunday morning. While the attendance was somewhat smaller than last year, the interest was unabated. The advisability of establishing a membership group of research fellows was vigorously discussed and laid over until next year for further consideration. A committee report on organization, the association prize award and several minor matters were also considered. This conference is a valuable influence in enabling the association to render more effective services to its members.

The Conference of Science Teachers promoted by the Committee on the Place of Science in Education held two sessions and a luncheon meeting on Saturday. The programs were attended by large and enthusiastic audiences. At the afternoon meeting it was voted to form an American Science Teachers' Association. A steering committee was instructed to perfect the organization and arrange a program for the St. Louis meeting of the association next December. The committee consisted of: Harry A. Carpenter, Rochester, N. Y., *chairman;* Florence Billig, Wayne University, Detroit, Mich.; Otis W. Caldwell, New York, N. Y.; W. L. Eikenberry, State Teachers College, Trenton, N. J.; John A. Hollinger, Pittsburgh Public Schools, Pittsburgh, Pa.; Wilhelm Segerblom, Phillips Exeter Academy, Exeter, N. H.; Homer W. LeSourd, Milton Academy, Milton, Mass., and Ralph K. Watkins, Columbia, Mo. These members were instructed to add others to the managing committee as needed.

RESOLUTIONS ADOPTED AT PITTSBURGH

Numerous requests for action on scientific problems were presented by sections and affiliated societies. After careful study by the executive committee and discussion in the council, the following resolutions were approved for publication and dissemination:

Relation of the American Association to Human Welfare

WHEREAS, the objective of science is knowledge of man and of the world in which he lives; and

WHEREAS, upon this knowledge is based man's opportunity to live more intelligently, to work more effectively and to experience greater comfort and satisfaction; and

WHEREAS, the justification of the work and purpose of the American Association for the Advancement of Science is found in the contributions of this work to human welfare; and

WHEREAS, the American Association for the Advancement of Science, founded in 1848 and incorporated in 1874, with its 18,000 members and 141 affiliated societies covering the entire field of pure and applied science, including sociology, economics and education, and with its administrative offices in the Smithsonian Institution of Washington, has been and is well and permanently organized to administer funds for the advancement of science; therefore be it

Resolved, that the American Association for the Advancement of Science is prepared to accept and administer additional funds for the advancement of science and the promotion of national welfare.

Federal Support for Scientific Work

WHEREAS, development and application of science have been basic to the economic and social progress of nations, making possible such movements as universal education, abolition of child labor and slavery, emancipation of women, insurance and pensions, moderate hours of labor and great improvement in the standards of health, comfort and satisfaction in living; and

WHEREAS, scientific developments have not only conferred general social benefits, but in particular have been largely effective in leading to recovery from previous depressions,—as the railroad industry following the depression of 1870, the electric industry following that of 1896 and the automobile industry following that of 1907; and

WHEREAS, scientific research is a productive investment proven by experience to yield a high rate of return, as illustrated by the saving of $2,000,000,000 per year from the Bessemer Steel process and of over $1,000,000 per day from the modern incandescent lamp, and as illustrated also by the entire chemical, electrical, communication, transportation and metallurgical industries and by the enormous employment in such industries; and

WHEREAS, progressive foreign nations have recognized the importance of maintaining their scientific strength at a high productive level and have provided for this maintenance by allocation of funds to support scientific work on a national scale; and

WHEREAS, there now exists in America a situation demanding as never before an intelligent use of our national resources; and

WHEREAS, there are manifold problems in health, safety, agriculture, better use of resources, development of new products and processes whose social value and urgent need are unquestioned but whose solution is being seriously hampered by lack of funds for research, which have been greatly curtailed at this time when properly directed scientific work is more than ever needed; and

WHEREAS, the great national planning program, which is now under consideration for the use of our physical resources of soil, minerals and crops, will be seriously

deficient unless it includes provisions for utilizing the scientific resources of the country for creative work; therefore be it

Resolved, that aggressive governmental support of scientific work is essential to any sound program of building for the future national welfare, and is essential if this country is to do its full part in the further advance of civilization and if it is to enjoy its proper share in the benefits of this advance; and be it further

Resolved, that copies of this resolution be sent to the President of the United States, to the members of his Cabinet and to the members of the Congress.

A Pure Food and Drug Act

Resolved, that the American Association for the Advancement of Science, with more than 18,000 members and 141 associated societies and academies representing a total membership of more than 725,000, feels that there is a real need for a careful and sane revision of the Pure Food and Drug Act, which has served so effectively over a long period of time.

It seems reasonable and desirable that cosmetics should be included in any new bill which is presented and that in order to safeguard more adequately public health and public welfare, manufacturers, their salesmen or other agents, should be allowed to use in their advertising, printed, broadcasted or otherwise, only such statements as are not misleading and are essentially in accordance with fact.

Status of Land Utilization Agencies

Resolved, by the American Association for the Advancement of Science, that any reorganization of the United States Government agencies should provide for the continuance in the Department of Agriculture of the land utilization agencies now there, including the Bureau of Chemistry and Soils, Forest Service, Biological Survey, and the addition of such other agencies as have to do with the agricultural, forest or range use of the public domain or the protection thereof from erosion.

Animal Experimentation for Scientific and Medical Purposes

The American Association for the Advancement of Science, which has repeatedly recorded its protest against the enactment of legislation prohibiting animal experimentation for scientific and medical purposes, hereby reaffirms its vigorous opposition to the adoption of legislation in Congress or by state or local authorities prohibiting the use of dogs or other animals for medical experimentation.

This association is in accord with the practically unanimous and often expressed authoritative voice of science and medicine that animal experimentation has conferred inestimable benefits upon mankind, as well as upon animals themselves, and is essential to the progress of the biological and medical sciences.

The history of medical discovery affords countless examples of the necessity for the use of dogs and other animals in certain kinds of experiment, as may be illustrated by the experiments leading to the recent discoveries of insulin in the treatment of diabetes and of liver extract in the treatment of pernicious anemia.

The conditions under which animal experimentation is conducted in government and medical laboratories and in other laboratories of chartered institutions devoted to scientific research, afford every safeguard against the infliction of unnecessary suffering upon the animals.

This association, with a membership of over 18,000, with affiliated technical societies and academies representing a total membership list of more than 250,000 persons including representatives of all the sciences of nature and of man, is confident that if legislators become fully informed of the injury which would be inflicted upon the progress of curative and preventive medicine by such legislation any such bills will not receive their favorable consideration.

Pollution of Public Waters

Whereas, the degree of control of pollution of coastal and inland waters by domestic and industrial wastes which is essential for public health and national welfare has not yet been achieved and can not be without further development and coordination of federal, state and local authority,

Therefore, be it resolved that the American Association for the Advancement of Science, meeting at Pittsburgh, urgently recommends the adoption of legislation adequate to control pollution of public waters.

Science Advisory Board

Resolved, that the Council of the American Association for the Advancement of Science, with more than 18,000 members and 141 associated societies and academies representing a total membership of more than 725,000, appreciates the judgment of the President of the United States in appointing a Science Advisory Board and hopes that all problems of the Government involving scientific problems may be referred to this Board for its recommendations before action is taken.

Proposed Transfer of Forest Service

Resolved, by the American Association for the Advancement of Science, that any governmental reorganization planned should provide that the United States Forest Service remain, as at present, a part of the United States Department of Agriculture.

Concerning a U. S. Botanical Garden

Resolved, by the Council of the American Association for the Advancement of Science, that the efforts now being made to establish at Washington, D. C., an adequate United States Botanical Garden under effective scientific control be heartily approved.

THE ANNUAL SCIENCE EXHIBITION

(*By F. C. Brown, director of exhibits*)

The arrangements for this year's exhibition were an improvement over any held in the past. This was due in part because Pittsburgh is a great technical center and was readily accessible to the exhibitors and to the members of the association. Special credit, however, should be given to the local committee on exhibits. Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, made a distinctive and generous contribution by preparing adequate quarters. Dr. H. S. Coleman, associate director, gave

a large part of his time to the preparations. Dr. L. O. Grondahl as chairman carried the burden of the work in Pittsburgh both before and during the meetings. This committee worked most efficiently. Through planned cooperation with the numerous technical groups in and about Pittsburgh we had, in the opinion of one prominent exhibitor, "the most distinguished body of visitors ever seen at any exhibition held in that city." The value of the effort expended by many people, including the officers of the societies, was very great. The opinion prevailed that the association brought an unusually interesting exhibition to Pittsburgh.

The success of the exhibition can be attributed to a great extent to the care and expense undertaken by those who prepared the displays and demonstrations. The industrial firms set a new standard. This cooperation is recognized as vital. Many well-known associations and research institutions were represented. The association especially appreciated the contribution of the many eminent scientific men who personally devoted their time to exhibits and demonstrations. That these exhibits were well prepared may be indicated by quoting from a radio broadcast by Dr. Grondahl given at the close of the exhibition:

> During the meeting a cablegram was received from Europe describing certain results that had just been obtained in nuclear physics. It was immediately recognized that the results could be checked by the demonstration set-up in the exhibition. Moreover some important conclusions from the facts reported could be checked. The apparatus that was used in Europe was not of such a nature that this could be done. Upon receipt of the announcement of the new results, the scientists in charge of the corresponding exhibit at the Mellon Institute went to work after the crowds left the exhibition hall and spent the night making tests which yielded interesting new facts of scientific value before the next morning. This is a good illustration of the fact that the exhibition that has just closed was not a showing of museum apparatus or of material that had already passed into history but constituted a living and functioning demonstration of the way scientific progress is being made.

The attendance was more than 20,000 and some thousands were turned away, owing to the overcrowding of the exhibition hall. The publicity given to the exhibition was larger than ever before and the accuracy of the reports was a credit to the members of the National Association of Science Writers.

SCIENTIFIC SESSIONS

SECTION ON MATHEMATICS (A)

(*Reports from E. R. Hedrick and Edwin W. Schreiber*)

The meetings of the Section on Mathematics (A) were held in conjunction with those of the American Mathematical Society, the Mathematical Association of America and the National Council of Teachers of Mathematics. The American Mathematical Society held scientific sessions at the Carnegie Institute of Technology from Thursday to Saturday, at which 73 short papers were presented by their authors, in addition to the longer papers presented by invitation, which are described below. Abstracts of these will be printed in the January issue of the *Bulletin* of the society, and a general account of the meeting will appear in the March issue.

On Friday afternoon, President A. B. Coble delivered his retiring address as president of the society, on the topic, "The Geometry of the Weddle Manifold W_p," and Professor Albert Einstein delivered the Josiah Willard Gibbs Lecture of the society on the topic, "An Elementary Proof of the Theorem Concerning the Equivalence of Mass and Energy," before large and enthusiastic audiences. Both of these addresses will appear in the *Bulletin* of the society.

At the annual business meeting of the society on the same afternoon, the following officers were elected: *President,* Professor Solomon Lefschetz; *vice-president,* Professor Harry Bateman; *associate secretary,* Professor J. R. Kline; *member editorial committee of the Bulletin,* Professor W. R. Longley; *member editorial committee of the Transactions,* Professor J. D. Tamarkin; *member of editorial committee of the Colloquium Publications,* Professor R. L. Moore; *trustees,* Professors W. B. Fite, W. R. Longley, G. W. Mullins, Dr. Robert Henderson and Dean R. G. D. Richardson; *council,* Professors A. A. Albert, Harold Hotelling, R. E. Langer, D. V. Widder and R. L. Wilder.

On Friday evening there was a joint session of the Section on Mathematics (A) and the Section on Social and Economic Sciences (K), the American Mathematical Society, the Mathematical Association of America and the Econometric Society, on the general topic, "The Nature and Limitations of Statistical Proof." The following papers were read by invitation: "What is a Proof?" by Professor E. B. Wilson; "What Do Time-Series Correlation Coefficients Show?" by Professor C. F. Roos; "Statistical Proofs of Periodicity in Economic Series," by Professor H. T. Davis, and "Practical Difficulties in Proving Statistical Relationships," by Mr. Max Sasuly.

On Saturday afternoon there was a joint meeting of the American Mathematical Society and the American Physical Society, on the general topic, "Group Theory and Quantum Mechanics." The following papers were read by invitation: "Symmetry Relations in Various Physical Problems," by Professor E. P. Wigner; "Some Applications of Group Theory to Non-Relativistic Problems," by Professor J. H. Van Vleck;

"Some Applications of Group Theory to Dirac's Relativistic Theory," by Professor Gregory Breit.

The meetings of the Mathematical Association of America began with the joint session on Friday evening and extended through Saturday, Monday and Tuesday. On Saturday afternoon there was held a joint session of the Mathematical Association and the National Council of Teachers of Mathematics.

On Monday morning there was a joint session of the section with the American Mathematical Society and the Mathematical Association, at which Professor Arnold Dresden delivered his retiring address as president of the association on the topic "A Program for Mathematics," and Professor C. N. Moore delivered his retiring address as vice-president of the American Association and chairman of the Section on Mathematics, on the topic "Mathematics and Science." Reports of these meetings and of the sessions of the association on Monday afternoon and Tuesday morning will appear in the *American Mathematical Monthly*.

At the business meeting of the Mathematical Association on Monday afternoon, the following officers were elected: *President*, Professor D. R. Curtiss; *vice-presidents*, Professors L. L. Dines and A. J. Kempner; *members of the board of trustees* (to January, 1938), Professors H. E. Buchanan, Arnold Dresden, E. R. Hedrick, F. D. Murnaghan and (to January, 1937, *vice* D. R. Curtiss) J. O. Hassler.

For the Section on Mathematics (A) the following officers were elected: *Vice-president of the American Association and chairman of the section*, Professor T. H. Hildebrandt; *members of the committee of the section*, Professors E. B. Stouffer (elective, retiring in December, 1938), M. H. Ingraham and C. N. Moore (representing the Mathematical Society), C. S. Atchison and W. D. Cairns (representing the Mathematical Association). Professor Marston Morse was reelected by the section committee as a member of the executive committee of the section.

The National Council of Teachers of Mathematics met with the American Mathematical Society, the Mathematical Association of America and the Section on Mathematics for the first time. Approximately 135 were registered. At the opening session on Friday evening after an address of welcome by Professor Edwin G. Olds (Carnegie Institute of Technology), the response was made by Professor W. D. Reeve (Columbia University), who spoke at some length on certain topics on curricular revision. An interesting feature of the evening was a symposium on "Methods of Making Mathematics Interesting," by a group of teachers from the Pittsburgh high schools and directed by Dr. Elizabeth B. Cowley. The Saturday morning session was devoted to the general topic, "Mathematical Concepts of Value to High School Teachers." Professor H. W. Brinkman (Swarthmore College) presented an interesting paper on "Certain Concepts in Trigonometry." Professor C. C. MacDuffee (Ohio State University) read a logical paper on the "Different Kinds of Equality." At the morning session Professor W. D. Cairns displayed English text-books and examination papers collected while visiting English schools on a recent trip abroad. The exhibit, which included various charts of typical problems used for examination purposes in England, together with the standard text-books used in Britain, was available all day. The Saturday afternoon session was a joint meeting with the Mathematical Association of America on the topic "The Need for a Reorientation of Mathematics in the Secondary Schools." The first paper, entitled "From the Viewpoint of Modern Educational Theory," was presented by Professor P. W. Hutson (University of Pittsburgh). Professor W. L. Hart (University of Minnesota) read a paper entitled "From the Viewpoint of the University Professor of Mathematics." Dr. M. L. Hartung (University High School, Madison, Wis.) spoke on "From the Viewpoint of the High School Teacher."

The general dinner of the mathematical organizations was held on Saturday evening at the Hotel Webster Hall. Nearly 300 persons were in attendance. The dinner was presided over by Professor Dunham Jackson, who introduced Professor Albert Einstein as the distinguished guest of the occasion. Informal talks were made by Professors S. Lefschetz (incoming president of the society), G. D. Birkhoff and L. L. Dines.

SECTION ON PHYSICS (B)

(*Reports from Henry A. Barton, F. R. Watson, Robert G. Stone, Charles F. Brooks*)

An unusually large and well-attended meeting of the Section on Physics (B) and its affiliated societies was held at the Pittsburgh meeting. More societies met with the section than ever before, *viz.*, the American Physical Society, the American Meteorological Society, the American Association of Physics Teachers and the Acoustical Society of America.

The section followed its usual custom of holding no separate meeting but rather joint sessions with the American Physical Society. The program of the official session of the section, which was held on Thursday afternoon, consisted of an address on "Some Unusual Optical Problems," by R. W. Wood, vice-president and president-elect of the American Physical Society, and the address of C. J. Davisson, retiring vice-president of the Section on Physics, on "Electron Optics" (read by K. K. Darrow in the absence of Dr. Davisson). Henry G. Gale, vice-president of the section, presided.

The American Physical Society held sessions on Thursday, Friday and Saturday, approximately 95 papers being presented. Four simultaneous sessions on Thursday morning were: (1) On nuclear structure, radioactivity, neutrons, counters and cosmic rays, Henry A. Erikson presiding; (2) on miscellaneous interesting and important applications of physics, L. G. Hector presiding; (3) on films, light filters, fluorescence, luminescence, Stark effect and spectra, R. W. Wood and W. E. Forsythe presiding; and (4) on crystals, solids, diffraction of electrons and mass-spectroscopy, L. W. McKeehan and J. A. Becker presiding.

At the business meeting held on Thursday afternoon officers elected were announced as follows: *President*, R. W. Wood; *vice-president*, F. K. Richtmyer; *secretary*, W. L. Severinghaus; *treasurer*, G. B. Pegram; *managing editor* (1935–1937), John T. Tate; *members of the council* (1935–1938), G. Breit and K. K. Darrow; *members of the board of editors of The Physical Review* (1935–1937), W. V. Houston, R. S. Mulliken and I. I. Rabi. Further business included satisfactory reports by the treasurer and the managing editor.

On Thursday evening the society inspected, by invitation, the laboratories of the Gulf Research and Development Corporation.

Friday was devoted mainly to a symposium on "Heavy Hydrogen and Its Compounds," this being a joint symposium of the section with the Section on Chemistry and the American Association of Physics Teachers. The morning program was devoted to invited papers on the physical aspects of the subject, K. K. Darrow presiding. The papers were: "Interferometric Studies of Alpha Lines of Hydrogen and Deuterium," R. C. Gibbs; "The Use of Deuterium in Spectroscopic Investigations of Molecules," G. H. Dieke; "Magnetic Moment of the Deuton," Otto Stern; "Nuclear Reactions Produced by High-speed Deutons," M. A. Tuve. In the course of discussion a vote was taken in approval of the term "deuteron" instead of "deuton" or "diplon" for the deuterium nucleus.

The afternoon session was devoted to invited papers on the chemical aspects of the subject and is reported by the Section on Chemistry. Late in the afternoon a joint meeting with the American Mathematical Society was held to hear the Josiah Willard Gibbs Lecture.

In the evening a joint dinner was held with the American Association of Physics Teachers in the Webster Hall Hotel. Approximately 325 persons attended and heard addresses by R. W. Wood, toastmaster, K. T. Compton, K. K. Darrow, Henry G. Gale, L. O. Grondahl, R. A. Millikan, Frederick Palmer, Jr., W. F. G. Swann and A. G. Worthing.

On Saturday morning four simultaneous sessions were held: (1) On x-rays, crystal and liquid structure and fatigue of metals, J. Valasek presiding; (2) on wave mechanics, ether drift, nuclear magnetic moments and spins, Alpheus W. Smith and P. W. Bridgman presiding; (3) on sound, magnetism and miscellaneous topics, Herbert G. Dorsey presiding; (4) on high-speed rotating devices, photoelectric, photovoltaic and photoconductivity effects and miscellaneous topics, J. W. Beams and Jay W. Woodrow presiding.

Two sessions were held on Saturday afternoon, one a joint session with the Acoustical Society of America, D. C. Miller presiding. The other was a joint session with the American Mathematical Society devoted to "Group Theory and Quantum Mechanics," H. P. Robertson presiding (reported by the Section on Mathematics).

Some 400 physicists in all attended the sessions. One very agreeable and valuable feature of the meeting was the holding of joint symposia bringing different groups together and stimulating borderline subjects. The A. A. A. S. convention offers the best opportunity for such cooperative gatherings.

For the first time in its history, the Acoustical Society of America met in affiliation with the A. A. A. S. A joint meeting was arranged between the Acoustical Society, the Section on Physics and the American Physical Society. The program included a symposium on "Noise" and two invited papers. One of the invited papers was by B. G. Churcher, of the Metropolitan-Vickers Company, Manchester, England, on "A Loudness Scale for Industrial Noise Measurements." He showed that any loudness scale must be decided subjectively by hearing observations but should be expressed in energy units. Other speakers discussing this subject were Dr. E. J. Abbott, Dr. L. B. Ham and V. L. Chrisler. An important paper was delivered by Dr. V. O. Knudsen on "The Absorption of Sound in Gases," which described how methods employed in acoustics were cleverly adapted to give important and surprising results in the domain of molecular interactions.

The second invited paper was given by Dr. Hallowell Davis (Harvard University) on "The Electrical Phenomena of the Cochlea and the Auditory Nerve." His experiments indicated that the cochlea always responds to mechanical sound impulses, but that the auditory nerve is intermittent in its action while discharging electrical impulses along the nerves.

An ingenious demonstration by W. C. Dodd (Miami University) made visible three simple harmonic motions mutually at right angles. Dr. E. C. Wente, of the Bell Telephone Laboratories, described the various types of instruments available for measuring sound.

Attendance at the meetings varied from fifty to two hundred. C. R. Hanna, of the Westinghouse Com-

pany, was chairman of arrangements and program A banquet on Friday evening was attended by some fifty enthusiastic participants

The American Meteorological Society held four sessions on December 28 and 29, with 29 papers In a symposium on the hydro meteorology of the Ohio River, Montrose W Hayes reviewed the Weather Bureau's recent improvements in gauging and river stage forecasting, Colonel C L Hall (U S Engineers) showed how important weather prediction especially of sub zero temperatures and local down pours, was in the operation of the Ohio River movable dams, W C Devereaux described the efforts of the Weather Bureau to improve its river forecasts by use of slope discharge stage metering, W S Brotzman described the hydrology of the Monongahela and Allegheny Rivers, which join at Pittsburgh to form the Ohio, and J H Stewart showed a chart indicating a general parallel trend between Niagara River discharge and precipitation in the Ohio Basin, with an apparent lag of a few years in the lake levels

Aerology and aeronautical meteorology were discussed in seven papers W R Gregg (Chief, U S Weather Bureau) described the bureau's collection and use of upper air data in daily forecasting The daily soundings by airplane are analyzed with the aid of tephigram, Rossby diagram and vertical cross sections of the atmosphere along certain lines across the United States Dr K O Lange (Massachusetts Institute of Technology) demonstrated a new super sensitive airplane micro meteorograph made on the principle of the Jaumotte balloon meteorograph Not only is it so sensitive that it will give accurate results at maximum rates of airplane climb, but also the nature of the record obtained, with temperature and humidity plotted directly against pressure (height), permits a very quick reduction of the results Thus the new instrument is economical of time and permits the airplane ascent to be made nearer the synoptic hour and usually by daylight Lieutenant P G Hale (U S Navy) described meteorology in the Navy, especially the development of new apparatus for measurement of gustiness, and a sensitive aerometeorograph, with a lag of only 7½ seconds Though not so responsive as the new Lange meteorograph it is about eight times as sensitive as those generally in use in the United States and three times more sensitive than the European standard

In two papers on visibility W E K Middleton (Canadian Meteorological Office) indicated how Rayleigh's extinction coefficient depends chiefly on wave length and how, therefore, as a basic unit it may be used to equate visibility measurements made with photometers of special design under all observing conditions. Eric R Miller, discussing some wind velocity correlations, showed how the wind velocity at the Weather Bureau station in Madison had decreased with the growth of trees F R Garver, after summarizing the wind velocities of the free air envisioned a tower 1,000 feet or more high to harness at reasonable cost the great potential horsepower of the winds where essentially free of surface friction

Climatology was the major theme of several papers which reflected particular interest in correlation studies Dr H H Kimball, Dr C F Brooks and R G Stone (Blue Hill Observatory, Harvard University) presented, respectively, the latitudinal, altitudinal, seasonal and diurnal variations in the intensity and quality of solar radiation, twenty-eight new climatic maps of the whole North American continent for the Koppen Geiger, *Handbuch der Klimatologie* and types of fog régimes of the United States J K Rose from many simple and multiple correlations of various climatic elements with corn yields calculated separately for selected counties of the corn belt, concluded that on the margins of the corn belt, where yields show a correlation coefficient with selected weather elements from 0 90 to 0 99, the weather may have good forecasting value for corn yields C D Reed presented evidence of an 11 month period in Iowa temperatures indicating that next May would be moderately warm, and Professor C J Bollinger reported an intricate apparent chain of correlations between solar constant values, Caribbean Sea and Gulf of Mexico surface temperatures, and seasonal weather and crop yields in the southwestern states The drought in the northern plains area was described by Professor J C Jensen who thought that if run off were held back the greater evaporation would make such thunderstorms as occurred a little wetter and thus mitigate to some extent the heat and dryness of droughts J B Kincer indicated that man's responsibility for the drought could be considered as nil, since it was obvious that major processes of the weather were responsible and that corresponding dryness had occurred in the past before appreciable settlement The papers by Messrs Reed, Bollinger and Jensen drew much discussion

Short term forecasting on empirical bases was discussed by I R Tannehill (pressure differences between stations), Dr H J Franklin (cranberry frost forecasts) and W R Stevens (movements of isobars) Other papers concerned meteorological physics and instruments Dr E W Woolard reviewed the problem of the supporting power of a surface ice sheet Dr H Landsberg presented observations showing the relatively large number of condensation nuclei found over lowlands, especially in the vicinity of cities. A H Mears showed how aneroid barometers could be used for accurate determinations of pressures

Dr. I. M. Cline delivered the presidential address, entitled "A Century of Progress in the Study of Cyclones." With eminent fairness, in a sweeping comprehensive survey, he called attention to the long roll of investigators who have contributed in any notable way to our knowledge of the nature of cyclones. He devoted especial attention to the tropical cyclone, on which he is an authority.

At the annual meeting the society celebrated its fifteenth anniversary, and viewed with pleasure the rapidly increasing membership, reflecting revived interest in meteorology. Charles F. Brooks and Willis R. Gregg were reelected secretary and treasurer, and M. W. Hayes, H. C. Willett, A. H. Thiessen, F. W. Reichelderfer and G. F. McEwen were elected councilors for 1935–1937. Dr. I. M. Cline and E. L. Wells continue as president and vice-president. The society, by mail ballot, voted 229 to 22 to reduce the membership to one class, eliminating fellows.

SECTION ON CHEMISTRY (C)

(Report from J. H. Simons)

This section opened its meeting on Thursday afternoon with a symposium on "The Rôle of Chemistry in Education," planned to bridge the gap between the sections on chemistry and education. It was held jointly by these sections with the cooperation of the Division of Chemical Education of the American Chemical Society. Victor H. Noll presented a paper on "The Extent of Chemical Education," which gave a statistical account of chemical education in the various educational levels. "The Cultural Value of Chemistry in General Education" was presented by B. S. Hopkins, who stressed the cultural and esthetic side of the subject. "The Training Value of Chemistry in General Education" was treated by J. H. Simons. Alexander Silverman gave a scholarly address on "The Prerequisite and Collateral Value of Chemistry," and Webster N. Jones discussed in masterly fashion "The Profession of Chemistry."

On Friday both morning and afternoon sessions were devoted to a symposium on "Heavy Hydrogen and Its Compounds." This was held jointly with the Section on Physics and the American Physical Society. The account of the morning session is reported by the Section on Physics. In the afternoon H. L. Johnson reported on "The Chemical Separation of the Isotopes of Hydrogen," in which he gave data on the separation that results in reaction in which hydrogen is evolved; this was considered theoretically. "The Value of Deuterium in Reaction Kinetics" was treated by H. S. Taylor in a paper which contained much interesting material. John R. Bates presented "A Study of the Deuterium Exchange Reaction Involving Acetone," the material for which was obtained by himself and colleagues at the University of Michigan. F. G. Brickwedde discussed the properties of ortho- and para-deuterium and contrasted them with those of ortho- and para-hydrogen.

On Friday evening a well-attended dinner was held jointly with the Pittsburgh Section of the American Chemical Society. This was followed by the address of the retiring vice-president, Arthur B. Lamb, on the subject "Crystallogenetic Adsorbents." He discussed the adsorbent properties of certain crystalline hydrated silicates, which lose water but retain the original crystalline form. The high adsorbent properties and the selective action of these materials is remarkable.

On Saturday morning was held a session devoted to contributed papers. Raymond E. Birch presented a paper on "The Development and Properties of a Forsterite Refractory." He described the preparation and properties of this interesting material, which is a magnesium silicate with a melting point of 1,910 degrees C. and considerable resistance to the action of silica at high temperature. The interesting properties of tantalum carbide were discussed by Philip M. McKenna. This material of great potential use has a melting point above 4,000 degrees C. and is completely resistant to the action of acids. Its great hardness makes it of use in cutting tools. William A. Noyes gave an interesting address on "Electronic Theories," in which he outlined the historical development of these theories in an excellent fashion. The paper by Hazel C. Cameron on "The Effect of Vitamin A Intake upon the Incidence and Duration of Colds among Student Volunteers" was read in abstract. A. A. Horvath presented a paper on "The Phosphatides of the Soybean," and Arno Viehoever gave two papers on "The Hydrolytic Products of Amygdaline," and "Effective Antidotes."

SECTION ON ASTRONOMY (D)

(Report from Harlan T. Stetson)

The meetings of this section, held on Monday and Tuesday, were well attended, especially by those from the central section of the United States. At the Monday morning session, held at the Carnegie Institute of Technology, contributed papers were presented. The activities of the Allegheny Observatory were presented by Zaccheus Daniel on "The Parallax Program," by N. E. Wagman, who reported on the observations of Eros at the last opposition, and by papers on light curves of variable stars by Director F. C. Jordan and by Charles Hetzler, who demonstrated interesting results from infra-red plates taken with the Thaw refractor, using a color filter which, combined with the characteristics of the plate, gave sharp definition in the infra-red. The lag of the time

of maximum as compared with the visual observations was markedly indicated in several of the long-period variables. The extraordinarily interesting eclipsing star Zeta Aurigae was represented by two papers from the Mount Wilson Observatory; one dealing with the spectrographic investigations, by W. H. Christie and O. C. Wilson, and the other by P. Th. Oosterhoff presenting the results of photographic investigations.

Dr. Keivin Burns reported on the progress of his measurement of the cobalt spectrum in the sun and arc. His contribution in the measurement and analysis of some 1,500 lines discussed the similarity of partially resolved patterns in cobalt and lanthanum. The relationship involved makes possible a study of a considerable part of the hyperfine structure of cobalt through observation of the more easily resolved lanthanum lines.

A paper of unusual historical interest by Dr. Heber D. Curtis and Frank E. Robbins (University of Michigan) was entitled "A Nautical Almanac of 467 A. D." Three small fragments of papyrus, in the University of Michigan's extensive collection, contained astronomical data such as to warrant a painstaking search for the date of the document. From fragments containing the positions of the sun and moon and five planets it was possible to date the tables for the period from September 19 to October 31, 467 A. D. The ephemeris proves of historical interest, not only in exemplifying the method given by Theon of Alexandria in the fifth century, but also as showing the state of astronomical science at that early date.

On Monday afternoon a joint session was held with the Section on Geology and Geography, the first venture in bringing together scientists in these fields. The papers represented varied but often common interests, as in that of "A Proposal for an Institution for Meteoritic Research," by H. H. Nininger, and one on "Astronomical and Geological Ages," by Dr. William D. Urey (Massachusetts Institute of Technology). While a considerable variation in the age of the earth results from study of the uranium content of different specimens analyzed, Dr. Urey's researches on the uranium content of various specimens gave values for the age of the earth consistent with 2×10^9 years.

A paper by Dr. John A. Fleming (Carnegie Institution) summarized important researches in the earth's magnetism in correlations with the solar and atmospheric factors, a subject of increasing importance either from an astronomical or a geological view-point.

At 3:30 P. M. the address of the retiring vice-president of the section, Dr. V. M. Slipher (Lowell Observatory), was read, on the subject "The Atmospheres of the Planets as Inferred from Their Spectra." The address was illustrated by spectrograms and photographs taken by light of different wave-lengths by means of appropriate filters. These revealed the surprising importance of methane as responsible for most of the conspicuous features in the telescopic appearance of the major planets. The results of recent searches for water vapor and oxygen on Mars and Venus gave little encouragement to those who speculate on the possibilities of life on the two terrestrial planets Mars and Venus.

Many of those in attendance on the section enjoyed the address of the retiring president of the American Association in Music Hall on Monday evening, when Professor Henry Norris Russell spoke on "The Atmospheres of the Planets."

The Tuesday morning session was held by invitation of Director F. C. Jordan at the Allegheny Observatory. Papers were presented varying in interest from "Optical Tests of the 20-inch Refractor of the Van Vleck Observatory" to a discussion of the variability in the transmission time of transatlantic time signals. After a full program the section adjourned at noon and inspected the work and equipment of Allegheny Observatory, the outstanding center of astronomical interest in the vicinity of Pittsburgh.

SECTION ON GEOLOGY AND GEOGRAPHY (E)

(Report from Kirtley F. Mather)

Many of the fellows of the Geological Society of America, which had been in session in Rochester, New York, from December 27 to 29, joined with the members of the Section on Geology and Geography in four sessions which were held on Monday and Tuesday, under the chairmanship of Professor James B. Macelwane (St. Louis University), vice-president of the section. The Monday afternoon meeting was a joint session with the Section on Astronomy. Abstracts of all papers presented will be published in February in the *Proceedings* of the Geological Society of America. On Monday evening a well-attended dinner was held in Webster Hall, at which Dr. George H. Ashley (state geologist of Pennsylvania) delivered an address concerning "Evolution and the Moral Order."

The address of the retiring vice-president, Professor Rollin T. Chamberlin (University of Chicago), dealt with certain aspects of geologic classification and correlation, stressing especially the problems of demarcation of the limits of the several eras of earth history. Several of the papers delivered on Monday morning were devoted to seismology. Those by N. H. Heck and H. E. McComb (U. S. Coast and Geodetic Survey) described the major earthquakes and the equipment of the seismograph stations in the Appalachian

Region. These papers and the extended discussion which followed them showed that the recently renewed interest in seismology in this region has already resulted in vast improvement in the equipment available for observations.

The majority of the papers presented on Tuesday were devoted to the consideration of stratigraphic and structural problems of the Appalachian region. Charles R. Fettke (Carnegie Institute of Technology) reported the results of the correlation of data secured in deep wells drilled in Pennsylvania and New York; B. L. Miller (Lehigh University) called attention to numerous unsolved problems in the geology of eastern Pennsylvania; H. M. Fridley (West Virginia University) and R. E. Sherrill (University of Pittsburgh) described the relation between the slope of peneplains and the regional dip of the Allegheny plateau.

Considerable interest was manifested in the discussion of a paper by W. H. Hobbs (University of Michigan) in which stress was placed upon the efficiency of the sand blast as an agent of erosion in the zone peripheral to the retreating ice sheets of each stage of the Glacial Period. Sidman P. Poole (Syracuse University) presented a study of Merida, Venezuela, from the point of view of the geographer, and I. W. Jones (Quebec Bureau of Mines) described the geology of north central Gaspé.

SECTION ON ZOOLOGICAL SCIENCES (F)

(Reports from George R. LaRue, H. B. Goodrich, H. B. Hungerford, A. I. Bourne, H. W. Stunkard, Lawrence E. Hicks)

The Section on Zoological Sciences held joint sessions with the American Society of Zoologists and affiliated societies from Thursday to Saturday. The annual dinner of the zoologists, held on Friday night at the University Club, drew a large attendance. Dr. George L. Streeter, Carnegie Institution, gave the after-dinner address on the subject, "The Education of an Anatomist." He discussed the education of four great anatomists, Aristotle, Vesalius, John Hunter and Franklin P. Mall. In their training he found no common denominator and concluded that great anatomists are born, not made. The complete address will be published in SCIENCE.

The American Society of Zoologists held its thirty-second annual meeting from December 27 to 29. The special features of the program were: (1) A symposium on "Mitosis," in which the following invitational papers were given: "The Morphology of the Mitotic Spindle," by Franz Schrader; "Modifications on Mitosis in Merogony and Gynogenesis," by Gerhard Fankhauser; "Differential Behavior of the Mitotic Figure in the Cleaving Insect Egg," by Alfred F. Huettner; and "Factors Influencing Chromosome Movements in Mitosis," by Charles W. Metz. About 300 were in attendance at the symposium. (2) There were two special sessions of invited papers, one a joint meeting with the American Society of Parasitologists on the "Immunological Relations between Host and Parasite." The second session was arranged by Dr. Robert Chambers, on "Cellular Physiology." The discussion was led by Dr. L. V. Heilbrunn. The regular sessions on "Embryology" and on "Endocrinology" attracted especial attention. The demonstration program on Friday afternoon, although not extensive, showed an advance over preceding programs in the attention given by the exhibitors to methods of display.

The zoologists held a joint dinner with the Wilson Ornithological Club, with an attendance of about 275. The address of the evening was given by Dr. George L. Streeter, vice-president of the Section on Zoological Sciences, on "The Education of an Anatomist." This was followed by the Biologists' Smoker, with probably over five hundred in attendance. The following were elected officers of the American Society of Zoologists for 1935: *President*, R. W. Hegner; *vice-president*, Sewall Wright.

The Entomological Society of America held its twenty-ninth annual meeting on Thursday, Friday and Saturday mornings. During the regular two days session there were presented twenty-five papers dealing with entomological research and a symposium entitled "Improved Technique in the Study of Insects." Nearly an entire day was devoted to the symposium, which proved to be the most interesting and profitable one the society has ever held. Each of ten major divisions of the subject was presented by a well-known specialist, who reported the recent worthwhile methods developed in his field and illustrated technique and equipment by drawings and displays. There was an unusual number of interesting papers on insect physiology.

The Saturday morning session was a joint meeting with the Ecological Society of America, during which twelve papers dealing with insect ecology were read. The annual address was given by Dr. C. H. Kennedy (Ohio State University), who spoke on "The Family and the Society." Taking for his purpose the thesis that the family represents the flow of energy from parent to offspring, Dr. Kennedy compared man and the insect in this regard and not to the discredit of certain insects. His discourse was a remarkable analysis of the relationship of parent to offspring in various groups. This annual address, as well as the general sessions of the society, was unusually well attended. The presiding officer at the Pittsburgh meeting was President C. L. Metcalf. Officers for 1935 are: *President*, C. H. Kennedy; *first vice-presi-*

dent, Leonard Haseman; *second vice-president,* W. T. M. Forbes; *secretary-treasurer,* H. B. Hungerford.

The program of the American Association of Economic Entomologists extended from Thursday through Saturday. The opening day was devoted chiefly to the programs of the three sections of Plant Quarantine, Extension and Apiculture, but was featured by the presentation of the annual address of the president in a general session. Brief reports were made of the three branch meetings during the year and also the Entomological Society of Ontario, Northern Central States Entomologists and Texas Entomology Society.

Friday afternoon was devoted to a program of invitation papers, summarizing the outstanding entomological features of the year.

The closing session on Saturday was devoted to a symposium on "International Entomological Problems," with addresses by Dr. A. W. Gibson (dominion entomologist of Canada), Dr. A. Dampf (government entomologist of Mexico) and Dr. L. A. Strong (chief of the U. S. Bureau of Entomology and Plant Quarantine).

Approximately 90 papers were submitted to be read in the general session. The financial condition of the association showed a gain over the previous year. Fifty-nine new members entered the association as associate members. The attendance proved very steady throughout the entire program and was approximately 300, including members and visitors. L. A. Strong, chief of the U. S. Bureau of Entomology and Plant Quarantine, Washington, D. C., was elected president.

The American Society of Parasitologists held its tenth annual meeting on Thursday, Friday and Saturday, under the presidency of Professor E. E. Tyzzer. The program contained 54 titles, 32 of which were presented either orally or by demonstration. The Thursday program consisted of papers on helminthology and protozoology, reporting researches on the morphology, life history, physiology and control of the parasites concerned. On Friday morning the society met in a joint session with the American Society of Zoologists; the program consisted of six invited papers dealing with various aspects of susceptibility and resistance to infection by animal parasites. Each of the speakers reported results of his own research and their bearing on the problem of immunity to parasitic infections. The discussion after the papers was led by Dr. W. W. Cort. Following the joint program the presidential address was given by Professor Tyzzer, who spoke on "Viewpoints and Orientation in Parasitology." This address will be published in the February, 1935, number of the *Journal of Parasitology.* At noon the society met for the annual luncheon and business meeting. Friday afternoon was reserved for the annual demonstration program, an outstanding feature of the meeting, and one that has received increasing attention in recent years. The demonstrations presented studies on the morphology, developmental cycles, taxonomy and pathology of various Protozoa, flatworms, nematodes and Acanthocephala. The Saturday morning program was devoted to papers of medical importance and diseases caused or transmitted by arthropods. In a special invited paper, Dr. Cornelius B. Philip, Rocky Mountain Laboratory, U. S. Public Health Service, reported on the 1934 epidemic of tick-borne tularemia in Montana sheep.

At the annual business meeting the following officers were elected for 1935: *President,* Colonel Chas. F. Craig; *vice-president,* H. J. Van Cleave; *council members for four years,* J. E. Ackert and W. W. Cort. The *secretary,* H. W. Stunkard, and *treasurer,* Justin Andrews, were reelected for two-year terms.

The Wilson Ornithological Club held its twentieth annual meeting in the Carnegie Museum on December 28 and 29; some 39 papers were presented covering nearly every phase of ornithological activity. The problems involved in explaining the distribution of breeding birds received special attention: a paper by W. E. Clyde Todd (Carnegie Museum) included maps of the breeding birds of Pennsylvania, one by Dr. Lawrence E. Hicks (Ohio State University) maps of the breeding birds of Ohio, and Maurice Brooks (University of West Virginia) discussed the Canadian component of the breeding birds of West Virginia. Another theme developed was the conservation of raptorial birds—hawks and owls. Warren F. Eaton (National Association of Audubon Societies) and Mrs. Charles N. Edge (Emergency Conservation Committee) reported on the securing as a refuge of Hawk Mountain in Pennsylvania, a lonely mountain ridge where for decades hunters have yearly slaughtered many thousands of the most valuable raptorial birds.

Exploration trips were reported upon with the aid of lantern slides or motion pictures. Dr. George M. Sutton (Cornell University) told of expeditions to British Columbia, Southampton Island and Churchill on Hudson Bay, and Margaret M. Nice of ornithological discoveries made in Europe. William C. Baker spoke of rare birds in Northern Michigan and Bayard H. Christy reviewed the bird life of Lake Superior. Robert A. Johnson and A. A. Myrus reviewed discoveries made in Labrador and along the Atlantic Coast. Albert F. Ganier presented a map of the nesting of the Bald Eagle in the Mississippi Valley and Edward A. McIlhenny excellent motion pictures of the countless thousands of blue geese, southern egrets and other waterfowl inhabiting the Louisiana

marshes. Dr. T. Gilbert Pearson stressed the appalling shortage of waterfowl as revealed in a survey of the Atlantic Coastal Waters.

Methods of bird study were again emphasized. Dr. S. Charles Kendeigh, of Western Reserve University, explained the best known methods of recording the abundance of birds. Ruth Trimble reported on the scientific bird study collections and Reinhold L. Fricke on the bird cases loaned for school use by the Carnegie Museum. John W. Handlin told of a remarkable experiment in bird study in West Virginia, which included an attendance of more than 50,000 persons on weekly bird hikes during the last eight years. E. L. Dakan, of Ohio State University, led a discussion of the problems involved in supervising university courses in ornithology. Charles J. Spiker reviewed the ornithological program in the United States national parks.

Dr. Gordon Wilson and Bayard H. Christy reviewed the life of Alexander Wilson, the father of American ornithology, and exhibited a fine collection of Wilsoniana assembled at the museum. Dr. Lawrence E. Hicks and Charles A. Dambach reported on the extent the European starlings captured in their studies compete with native bird life. More technical studies presented were of bird parasites by Edward S. Thomas, of the Ohio State Museum, observations on the blood of birds by Dr. Leonard B. Nice, of Ohio State University, and experiments on the resistance of pheasants and quail to cold and starvation by Paul L. Errington, of Iowa State College.

The meeting included also business sessions, exhibits, special entertainments, the annual dinner on Friday evening, an open house and reception at the Carnegie Museum on Saturday evening and a field trip on Sunday.

SECTION ON BOTANICAL SCIENCES (G)

(*Reports from S. F. Trelease, L. C. Petry, E. F. Hopkins, F. C. Meier, A. E. Murneek, H. M. Fitzpatrick, Edgar T. Wherry*)

The Section on Botanical Sciences met in joint session with associated societies on Friday afternoon. More than three hundred botanists attended this unusually interesting session. Dr. K. M. Wiegand delivered the retiring vice-presidential address for the section, his subject being "A Taxonomist's Experience with Hybrids in the Wild." This address was followed by a program of invitation papers. Dr. John T. Buchholz spoke on the relation of pollen-tube growth to the genetics of Datura. Dr. F. W. Went discussed experimental evidence on the rôle of hormones in plant growth. K. A. Ryerson gave an interesting illustrated talk on plant trails in North Africa.

The Botanical Society of America held its twenty-ninth annual meeting on Thursday, Friday and Saturday. The reading of papers before the sessions of the three sections occupied the forenoons.

The Thursday morning program of the general section consisted principally of papers dealing with plant anatomy. On Thursday afternoon the general and systematic sections met in a joint session with the Ecological Society of America and the physiological section met with the American Society of Plant Physiologists. On Thursday evening an informal and unscheduled round table discussion of "The Origin of the Angiosperms," led by Dr. H. Hamshaw Thomas (Cambridge University), was held, in which Dr. Thomas developed a theory of the origin of floral parts based upon his studies of plants of the lower Mesozoic age. The Friday morning program consisted of papers on cytology and flower morphology, together with two papers on other subjects. On Friday afternoon the society met jointly with the section and on Saturday afternoon with the American Society of Naturalists, the American Society of Zoologists and the Genetics Society of America, the program consisting of a symposium in "Cytogenetic Evolutionary Processes and Their Bearing on Evolution Theory." At the Saturday morning session papers on morphology, paleobotany and plant geography were presented.

The sessions of the physiological section for the presentation of papers were well attended. Abstracts of these papers are published in the December number of the *American Journal of Botany*. In addition to the sessions for contributed papers a joint meeting was held with the American Society of Plant Physiologists on Thursday afternoon: the program was a symposium on "Plant Hormones." This symposium was well attended and much interest was shown in the program, as indicated by the animated discussion which followed. The four invited speakers presented various sides of the hormone problem. Officers of the physiological section elected for 1935 are: *Chairman*, Sophia H. Eckerson; *vice-chairman*, Arthur J. Heinicke; *secretary-treasurer*, Edwin F. Hopkins.

The program of the systematic section on Thursday morning was a symposium on "The Status of Systematic Botany in American Colleges and Universities." The meeting was well attended and the reading of the papers was followed by extended discussion. The program on Friday morning consisted of contributed papers. At the Saturday morning session, two papers were presented; the section then adjourned to the Carnegie Museum, where the herbarium and plant habitat groups in the Hall of Botany were inspected, under the leadership of O. E. Jennings, curator. The following officers of the systematic section for 1935 were elected: *Chairman*, J. M. Greenman; *secretary*, R. E. Woodson, Jr.

The annual dinner for all botanists was held on

Friday evening with an attendance of 272. Dr. O. E. Jennings, local representative of the society and chairman of the systematic section, presided and introduced the retiring president, Dr. E. D. Merrill, of the New York Botanical Garden, who spoke on "Mental Excursions." The excursions referred to were into the fields of related sciences, and the speaker demonstrated by pertinent examples the value of such excursions in checking and correcting conclusions otherwise apparently acceptable.

The American Phytopathological Society held its twenty-sixth annual meeting from Thursday through Saturday with exceptionally good attendance from all parts of the country. Forty-three new members were elected, bringing the membership to 798. The following officers were elected: *President,* H. T. Gussow; *vice-president,* F. C. Meier; *secretary,* H. P. Barss; *treasurer* of the society and *business manager* of *Phytopathology,* H. A. Edson; *editor in chief* of *Phytopathology,* H. B. Humphrey; *councilor,* J. C. Walker. One hundred and ten papers were presented at the meeting. Two joint sessions were held, one with the Mycological Society of America, the other with the Section on Botanical Sciences. A special session on extension work in plant pathology called attention to responsibilities of plant pathologists in the present agricultural program. The annual dinner was attended by 243 persons.

The eleventh annual meeting of the American Society of Plant Physiologists, under the presidency of Dr. Burton E. Livingston, held four regular sessions, a joint session with the American Society for Horticultural Science and a symposium on "Plant Hormones" in cooperation with the physiological section of the Botanical Society of America. Forty-four papers were presented at the regular sessions and six at the joint session.

At the Plant Physiologists' dinner on Thursday evening Dr. F. M. Andrews read a memorial address prepared by Dr. Francis E. Lloyd on "Karl Ritter von Goebel." Dr. C. O. Appleman announced the election of Dr. F. F. Blackman to Charles Reid Barnes life membership and C. F. Hottes presented to Dr. C. A. Shull the Stephen Hales Prize Award of the society.

At the first regular session for the reading of scientific papers C. G. Barr and W. E. Loomis reported that the soluble reserve carbohydrates in vegetative corn plants are of dextrin-like nature. J. F. Trost found that soft and hard corn endosperms differ in the type of starch they contain. J. D. Sayre and V. H. Morris emphasized that in analyzing corn plants careful sampling and replications must be used to minimize differences due to inherent variability and the effects of environmental factors. In a second paper the same authors discussed a method of measuring the extent of corn root systems by the use of lithium salts placed in the soil between rows of plants. A third paper by these authors dealt with the accumulation and concentration of mineral elements in corn as affected by fertilizer treatment. C. E. Hartt presented evidence supporting the view that reducing sugars are the primary sugars in photosynthesis in sugar cane and that with maximum radiation they are produced in excess of the amount used for the formation of sucrose and starch. Invertase synthesizes sucrose in sugar cane, and the formation of this enzyme is favored by light of moderate intensity. M. G. Groner found that the more chlorophyll a corn plant contains the lower the amino nitrogen content in water extract of the leaves. J. C. Ireland reported on use of the photronic colorimeter in determination of chlorophyll content in sorghum. D. S. Francis and P. S. Hanshaw noted changes in radio-sensitivity of wheat seedlings as the interval from soaking to irradiation increased. L. C. Chesley stated that wheat and oat seedlings sprouted in light are less sensitive to x-rays than dark-sprouted seedlings.

The joint session with the American Society for Horticultural Science was devoted primarily to reading of physiological papers of horticultural interest. E. M. Emmert reported on the value of tests for nutrients in conducting tissues as indicators of the nutritional status in horticultural crops. L. R. Carolus showed illustrative evidence of symptoms of magnesium deficiency in horticultural plants and presented data on the value of magnesium fertilizers for the improvement of quality and increase of yield of certain vegetable crops. Further studies of little leaf or rosette of fruit trees were discussed by W. H. Chandler, D. R. Hoagland and P. L. Hibbard. W. F. Loehwing outlined methods of inducing sex-reversal in certain dioecious species, along with modifications of nitrogen, carbohydrates and mineral metabolism accompanying sex-reversal. P. J. Kramer presented results of experiments which indicate that the rate of growth and the beginning and ending of dormancy of seedlings of several species of forest trees may be affected by the length of day. And H. O. Werner described the effects of temperature, photoperiod and nitrogen level upon tuberization in the potato, emphasizing the inter-relation of these three environmental factors.

At the Saturday morning session E. S. Johnston reported on the sensitivity and double maximum phototropic response curve of the coleoptile of *Avena sativa.* R. B. Withrow described the effects of intensity and wave-length of artificial supplemental radiation on flowering of several horticultural plants, while R. Wenger stated that maximum and earliest flowering of *Aster* occurred when a supplementary illumination (Mazda lamps) of an intensity of 0.3 candle

power was given the plants. J C Carroll found that the concentration of inorganic nitrogen in Kentucky blue grass was affected by application of different carriers of nitrogen and that cold resistance of lawn grasses was increased by heavy applications of nitrogen fertilizers C P Sideris, B Krauss and H Y Young presented their studies on the distribution of nitrates in different tissues of the leaves and stems of pineapple plants, which seem to indicate that nitrates disappear more readily as they enter the chlorophyllous tissues of the leaves than those of the stem N W Stuart discussed certain sources of error in the determination of amino nitrogen in plant extracts by the Van Slyke method In a preliminary report E V Miller and Charles Brooks stated that reductase activity, expressed as rate of reduction of potassium permanganate by aqueous extracts of the peel, was lowest in lemons stored at 40° and highest at 50° F S V Eaton noted that the main symptoms of sulfur deficiency in the soybean are yellow green color and smaller size of the leaves and thinner stems The probable effects of lack of sulfur in the nutrient medium on metabolism of this plant were discussed W H Horr found that when *Aspergillus niger* and *Penicillium glaucum* were cultured on a mineral nutrient containing 1 per cent dextrose, 1 per cent levulose or 1 per cent manose with 1 per cent galactose there was a decided acceleration in development as compared to growth on media containing 2 per cent of any one of these sugars

The Saturday afternoon and evening sessions were devoted to continuation of reading of papers J T Sullivan described a new method of estimation of starch in woody plants, which is based upon its extraction from finely ground plant material by means of boiling calcium chloride solution D R Goddard dealt with certain phases of activation and correlated respiratory changes in the ascospores of *Neurospora tetrasperma* H A Runnels presented data on the effects of Bordeaux mixture and other spray materials on transpiration of a great variety of plants, with detailed discussion on the nature of the response M A Raines found that the elongation of young radicles of many plants is subject to a large variety of gross and minor environmental factors J S Cooley reported that the percentage of infectibility of apple roots with *Xylaria mali* is influenced by the season of the year when inoculation is made, with a maximum in April and May W E Loomis and L M Ewan emphasized that in soil the direction of root growth is determined more by gravity than by moisture supply D E H Frear described a photoelectric apparatus for measuring leaf area and F M Andrews stated that living nuclei of plant cells may be stained with the coloring water soluble substances that are present in other plant cells G A Greathouse and N W Stuart discussed the biochemical differences between hardy and non hardy clover plants and the influence of sub zero temperature on the freezable unfreezable water equilibrium in plant tissues F H Steinmetz analyzed the nature of winter injury to apple trees in Maine J P Bennett found that the lower the temperature at which potato tubers were stored the more rapid was the loss of both electrolytes and non-electrolytes when the tissue was placed in water Z I Kertesz and B R Nebel proposed a physico hydrostatic theory of cracking of cherries and M B Linford discussed the relationship between number and weight of fruitlets, flesh translucence and quality of pineapples The thermo electric method of measuring osmotic potentials in plant tissues was emphasized by B S Meyer and E M Herrick, and W E Tottingham and R Nagy suggested that the peculiar blackening of cooked potatoes apparently is due to oxidation of tyrosine and tryptophane to melanin pigments G M Shear and N A Pettinger showed the effects of soil reaction on growth of ornamental plants but could not find a relationship between available calcium and frenching of tobacco W E Loomis and N L Noecker reported that dandelions in lawns can be eradicated by spraying the lawns with petroleum distillates or distillate furfural emulsions The program was concluded by a humorous and entertaining address by P A Young on microscopic observations on forming and breaking creosoap emulsions of petroleum oils

The Mycological Society of America held its third annual meeting from December 27 to 29, with President Herbert S Jackson of Toronto University in the chair At the business meeting reports presented by the secretary treasurer and managing editor of *Mycologia* showed the society and its journal to be in sound financial condition The membership is growing slowly New officers elected for 1935 are B O Dodge, *president,* John Dearness, *vice president,* and C L Shear, *councilor* The council reelected J A Stevenson to serve an additional five year term as associate editor of *Mycologia* A report was read by the president calling attention to the outstanding success of the summer foray held at Seventh Lake, N. Y., in the Adirondacks in August and expressing appreciation of the hospitality of Professor F C Stewart and Mrs Stewart on that occasion A committee was named to draft an expression of regret at the loss by death during the year of Thomas H Macbride, Frank L Stevens, Mrs Esther Lewis and Charles E Fairman Joint sessions were held with the Section on Botanical Sciences and the American Phytopathological Society Saturday afternoon was set aside for the display of exhibits and the explanation of demonstrations of research materials The papers read at the regular sessions dealt with many groups of fungi and

displayed a wide and diverse interest Outstanding contributions were made by S M Pady on intracellular mycelium in the rusts, H S Jackson and J W Sinden on Heterobasidiomycetes, W R Hatch on Allomyces, John E Sass on the presence of a Golgi apparatus in the basidium, Alex H Smith on the genus Mycena, and P L Rusden on the development of certain Gasteromycetes Several students read papers in the field of medical mycology

The American Fern Society met on Saturday afternoon Four papers were presented, three on the distribution of ferns in Pennsylvania, and one on the climbing fern and its discovery by John Bartram

PROGRAMS RELATED TO BOTH ZOOLOGICAL AND BOTANICAL SCIENCES (F AND G)

(*Reports from E W Lindstrom, A G Vestal, P W Whiting, J E Ackert, J G Needham*)

The Biologists' Smoker, sponsored by the American Society of Naturalists, was held on Friday evening at the University Club An unusual number of participants, estimated at 650, necessitated the use of two large halls

On Saturday afternoon the annual Naturalists' symposium drew together an audience of over 300 Vice President E B Babcock presided, the subject being "Cytogenetic Evolutionary Processes and Their Bearing on Evolution Theory" Dr R A Brink, speaking on the botanical phases of the problem, showed how amphidiploidy, changes in chromosome number not involving the whole genom and structural changes of the chromosomes, all were capable of causing evolutionary changes in plants Dr M Demerec spoke on "The Rôle of Genes in Evolution," a critical analysis of gene behavior which was shown to be consistent with modern interpretations of evolutionary methods The third paper, by Dr C L Fenton, on "Factors of Evolution in Fossil Series," was read by the secretary Paleontological discoveries, particularly involving brachiopod series of fossils, were interpreted in terms of modern genetics Stability of the genotype, evolutionary change with relaxation of natural selection pressure, polyploidy and even gene mutations of shell ornament and physiology were suggestively illustrated with fossil series

The annual Naturalists' dinner, held on Saturday evening, was one of the most successful in recent years, with an attendance of 142 Dr C E McClung gave a short paper on "Evolution of the Chromosome Concept," a historical analysis of the part played by the earlier workers in cytology as they bore on the modern developments The retiring president of the Naturalists, Dr A Franklin Shull, followed with a brilliant critique of evolutionary concepts under the title of "Weismann and Haeckel,' One Hundred Years." Using modern genetic concepts as a base, Dr Shull subjected old and new hypotheses of evolutionary change to a critical scrutiny, in which certain theories of variation and especially of adaptation were attributed to wishful thinking

The twentieth annual meeting of the Ecological Society of America began on Thursday morning with an account of water-content of leaves of the California buckeye by Dr Delzie Demaree He found no simple correlations with fluctuations of external conditions Dr M T Townsend gave methods for following migrations and the wandering tendency of small mammals from sex ratios of individuals trapped Dr A G Vestal emphasized the value of vegetation components in addition to the usual units (plant associations) for analyzing mixed or compound vegetation Dr Ada Hayden showed the great plasticity of two Iowa species of Polygonum, and described their economic rôles Dr S Charles Kendeigh gave results of a long continued study of biological and environmental factors affecting yearly abundance of the eastern house wren

The Thursday afternoon joint program of ecologists and botanists included data from Dr Demaree and from Dr Edith A Purer, showing that many plants, particularly in regions with a long dry season, do absorb water in usable amounts by means of their above ground parts, contrary to long maintained belief of botanists Dr A P Dachnowski Stokes described peat lands as effective reservoirs of rainfall and water supplies, regulating stream flow and preventing too great lowering of ground water levels Preservation of these areas and their native vegetation is urged Homer A Jack showed that mats of the reindeer lichen intercept all moisture from rains not exceeding 0 12 inches Miss Miriam Bomhard showed that Louisiana palmettos of both trunked and stemless types represent a single polymorphic species Professor Herbert C Hanson presented a study of resistance to erosion by native plant cover types in the badlands of western North Dakota Two studies of gypsum vegetation in New Mexico were offered by Professor Fred W Emerson, who described the White Sands of the Alamogordo desert east of the San Andreas Mountains, and by Dr R S Campbell, in the Jornada experimental range west of the San Andreas At the ecologists' dinner at the University Club on Thursday evening, announcement was made of a Festschrift number of *Ecology* in honor of Professor Henry C Cowles

Friday morning was devoted to a session of three long papers Dr George D Fuller gave the first, his address as president of the Ecological Society, on "Post-glacial Vegetation of the Lake Michigan Region," based on recent pollen analysis studies Dr C Skottsberg, of Goteborg, Sweden, next described the northernmost rain forest of Chile, occupying part of

a mountain range in chaparral or semi desert surroundings Dr William S Cooper showed pictures, many from the air, of sand dunes of the Pacific coast and their vegetation, from the Coos Bay district to Sonora

On Friday afternoon a joint session with the Society of American Foresters began with a motion picture account of the Forest Research Institute, Dehra Dun, United Provinces, India, by Dr R Maclagan Gorrie Dr Robert B Gordon presented an ecological survey of the Allegany State Park, for which comparison with early records was possible Dr Lewis M Turner emphasized the influence of topographic and soil factors on growth of pines in Southern Arkansas Professor George E Nichols showed that white pine is a normal constituent of climax forests in the Huron Mountains of northern Michigan Individual pines come up in openings, grow well and persist for hundreds of years Dr C F Korstian gave results of trenched plot experiments in the North Carolina forests, which confirm the idea that soil moisture may be of greater moment than light in forest competition A L McComb showed that white pine stands in northwestern Pennsylvania usually originated on open sites Professor A H Wright spoke of nature preserves for special purposes which too greatly subordinate other purposes, and made a plea for custody of ecological preserves by universities or science organizations

At the business session, Dr Walter Penn Taylor (U S Biological Survey) was elected president for 1935, and Dr E Lucy Braun (University of Cincinnati), vice president Among the resolutions adopted was one for preservation of peat areas for water conservation and as part of the nation's economic program of keeping submarginal lands out of cultivation

On Saturday morning a joint session with the Entomological Society of America included papers on inorganic salts as influencing growth of experimental insect populations, by Ralph J Bushnell, effect of nutrition on development of a cockroach, by R M Melampy, and the ecological antagonism exerted by bots of the horse toward worm parasites, by Robert D Glasgow Dr Walter Carter described the microscopic internal symbionts of a scale insect of the pineapple, and showed a relation between different stages of the symbiont and degrees of injury worked upon the host plant in spots surrounding punctures made by the insect D M DeLong discussed ecological factors affecting distribution of Empoasca F Martin Brown showed attempts to correlate insect distribution in Mexico and Central America with climatic zones A E Emerson showed how two closely similar species of British Guiana termites were first distinguished by their having different beetle associates Gordon W Haug discussed ant populations in Mississippi A A Granovsky demonstrated means of combating the white grub menace to new tree plantings in Minnesota Orlando Park described apparatus for recording activity of nocturnal insects and determining whether rhythm in activity is environmental or inherent Such studies upon a fungus feeding beetle, Megalodachne, by Park and Otto Sejba, were also reported Saturday afternoon an ecologists' field trip went to Crouse's Run, north of Pittsburgh, under the guidance of Dr Otto E Jennings, of the Carnegie Museum

The Genetics Society of America held its third winter meeting at the Pennsylvania College for Women with regular sessions for the reading of papers on Thursday Friday and Saturday mornings Demonstrations were held on Friday afternoon at the University of Pittsburgh Interest centered about cytogenetics, with especial emphasis on salivary gland chromosomes showing localization of genes by means of breaks and rearrangements and especially by minute deletions

The American Microscopical Society held its fifty third annual meeting on Saturday The following officers were elected for 1935 *President,* Professor J E Guberlet, *first vice president,* Professor F D Heald, *second vice president,* Dr R L King, *treasurer* (3 years) Professor A M Chickering, *elective member of executive committee* (3 years), Professor H W Stunkard J E Guberlet and J E Ackert were named to represent the society in the council of the American Association The society is continuing its cooperation with *Biological Abstracts* in furnishing authors' abstracts of the papers published in the *Transactions of the American Microscopical Society*

The special program on hydrobiology and aquiculture listed seventeen papers discussing algae, lake plankton, insect emergence, propagation of Daphnia and of midge larvae, bottom faunas, and other subjects of interest to students of inland waters, and concluded with a very interesting movie illustrating the biology of the blue crab There was much interest shown by the large audience that stayed throughout a rather lengthy session

SECTION ON ANTHROPOLOGY (H)

(Report from Wilton Marion Krogman)

The section held joint sessions with the American Anthropological Association and the American Folk Lore Society, from December 27 to 29 An outstanding event of the sessions was the opportunity to discuss with Commissioner John Collier, of the Bureau of Indian Affairs, problems of rehabilitation of the Indians of the United States as contained or implied in the Wheeler-Howard Act The commissioner voiced the necessity of a more complete knowledge of

Indian culture as a prerequisite to wise and just administration, and stressed the fact that readjustment must be in accord with Indian tradition and culture The several organizations went on record as approving in principle the legislative policies outlined and pledging their cooperation in the adjudication of detailed problems

Professor Griffith Taylor presented his "Zones and Strata" theory of human migration, applying ecological principles to the evolution of racial types of man and the spread of his culture It was pointed out that, if Asia be accepted as a point of origin, there are three principal avenues of cultural spread Eur Africa, Oceania (Malaya Australia) and the Americas These avenues were utilized in order with the result that, stratigraphically speaking the Negroids and their variants are basic and earliest, with the round headed populations—Alpine and Mongoloid—superimposed and latest Professor Taylor s hypotheses, while not accepted in detail, were recognized as a contribution in methodology which may lead to a better understanding of racial movements

In a round table discussion of stone hatchets and their variants Professor Warren K Moorehead announced the results of his study of distribution areas of stone implements of the American Indian He recognized two Mound Culture areas—northern and southern—the former dominated by Hopewell and Fort Ancient culture complexes, the latter by Caddoan and Etowahan Mr Frederick Johnson elaborated upon the general theme by presenting a detailed method of classifying stone cutting tools under two main divisions—chopping and planing

The session of the American Folk Lore Society centered upon the theme of the rôle of folk lore in the interpretation of cultural contact, and in the elucidation of native elements still resident in an otherwise sophisticated community Mrs Elsie Clews Parsons, in a discussion of Indian elements among Zapotecan folk tales, made the pertinent observation that the more stylized, the more ceremonialized, a given culture, the less likelihood that generalized folk elements will persist as traditional tales In an analysis of Southwestern folksongs Dr A L Campa demonstrated the possibility of analyzing Indian, Spanish and cowboy songs as evidence of differing cultural backgrounds

At a symposium of problems of chronology in North America several papers were offered which throw light upon time and sequence of physical type and culture Professor A E Jenks announced the recovery of fragmentary human remains associated with flint implements of the Yuma Folsom type, at Brown's Valley, Minnesota The time was assigned to the early Tintah stage of the outlet of the glacial Lake Agassiz—an indicated 8,000 to 12,000 years ago The type, definitely American Indian, was assigned to the Algonkin Munsee Miss Florence Hawley reported upon her study of dendrochronology in the Mississippi Valley, cooperating with the University of Chicago and the TVA In the Norris Basin dating has been carried back to 1315 A D , in Kentucky back to 1638 A D

In a study of prehistoric relationships in the northern Mississippi Valley Thorne Deuel recognized the Woodland basic culture as being subdivided into Red Ochre, Central Basin and Tampico phases, the Mississippi basic culture was similarly subdivided into Upper (Fort Ancient), Middle (Cahokia and Aztalan) and Lower (Etowah and Moundsville) The sequence was as given, but relative time was not stated Dr W A Ritchie then presented his study of culture sequence and chronology in the New York area The Archaic Algonkin, *ca* 1000 B C, were a long headed people possessing a nomadic hunting and fishing culture At about the beginning of the Christian era the Second Algonkin Period supervened, with a broader headed semi nomadic people, who introduced agriculture At the beginning of this period an Eskimoid influence was felt, at its end Mound influence could be traced About 1000 A D the Third Algonkin Period opened, soon to fall under the influence of the Iroquois (*ca* 1300 A D), and ultimately that of the Whites (*ca* 1600 A D)

The Saturday morning session of the section was devoted to physical anthropology In a discussion of human hair Miss Madeline Kneberg demonstrated that hair form in microscopic cross section is not dependent upon hair shape, *i e*, straightness, waviness, curliness or frizzled Hair from the same head and sections from the same hair shaft revealed no correlations in cross section The necessity of a more critical technique was emphasized K B M Crooks reported upon a height weight comparison of White and Negro male college students Mr Crooks presented evidence to show that despite a possibly less favorable economic environment which gets him off to a slower start, the Negro grows for a longer period so that ultimately his height weight ratio compares very favorably with that of the White

On Friday evening, Dr T Wingate Todd ga e the address of the retiring vice president on "Anthropology and Growth" The address will be published in SCIENCE At the business session of the section Dr N C Nelson was named as chairman for 1935

SECTION ON PSYCHOLOGY (I)

(Report from John A McGeoch)

The sessions of the section were held from Thursday to Saturday The first session was devoted to papers on the measurement of personality traits and of intelligence N L Hoopingarner described a

method of personality analysis which yields significant predictions of vocational success H H Remmers reported that a number of experiments with generalized social attitude scales had yielded relatively high coefficients of validity and reliability and had shown these scales to be useful measuring instruments Irving Lorge subjected the Bernreuter Personality Inventory to a critical analysis and concluded that certain of the supposedly fundamental inter trait correlations were spurious After a critical examination of procedure in aptitude testing, H M Johnson described a new and logically sound method This method requires the formulation of all the concurrent demands which a worker must satisfy and the interchangeable skills by which they may be met Only two classifications, success or failure, are possible S L Pressey reported two studies of changes in interests and attitudes in large samplings over periods of 10 to 12 years One notable change was in the direction of a liberalization of attitude toward certain moral and social problems H C Lehman reviewed the methodological errors involved in equating fraternity and non fraternity students H F Dickenson found that secondary discriminative responses on intelligence tests were superior to primary ones

There were two parallel sessions on Thursday afternoon, one on experimental and physiological psychology, the other on social and political psychology In the session on experimental and physiological problems Gregory J Schramm attempted to generalize the results of experimental work on emotions in a periodic table of emotional phases Herbert Woodrow reported that in the discrimination of time intervals the effective standard is the resultant of the influence of two remote standards, *viz* the absolute indifference interval and an interval equal to the average length of the preceding series of intervals, upon the actually given first interval Certain important relations between practise and the influence of remote standards were discovered A report of the onset and development during fetal life of responses released by specific stimuli which are important in post natal life because they are then concerned in the effective functioning of receptors was made by Leonard Carmichael A total of 178 guinea pig fetuses comprised the material T N Salmon and A F Blakeslee found that individuals differ in taste sensitivity to phenylthio carbamide from one time to another The changes may occur within intervals as short as 15 minutes, they have not been correlated with environment or routine A F Blakeslee and T N Salmon obtained wide individual differences in the taste thresholds of 47 subjects for 10 bitter substances The discovery of high intercorrelations between different methods of scoring the galvanic skin response led W A Hunt to recommend that research should concentrate on an analysis of the response itself W H Gantt and J S Light reported, in a paper of major theoretical importance, that, after exclusion of the efferent peripheral nerve and effector, these mechanisms are not essential for conditioned reflex formation This points toward learning as a central phenomenon In two series of experiments on the adaptation of cold and warmth to punctiform stimulation K M Dallenbach obtained the significant result that adaptation occurs in the temperature senses as well as in other modalities

In the session on social and political psychology J B Maller gave an analysis of the psychological and social characteristics of political districts in New York City during the last presidential election and the last election of mayor The districts carried by the Fusion party candidate were superior, by nearly all measures, to those carried by the Tammany candidate Margaret Mead described the conditioning as social attitudes in a primitive Papuan speaking tribe, the Arapesh of New Guinea, and the influence of early training upon adult behavior From a study of the reaction of representative citizens to political party names and of response to party platforms, G W Hartmann concluded that there is a sharp discrepancy between what American citizens want and the political channels through which they seek to attain it H J P Schubert reviewed the vocational work program at the Transient Center at Buffalo and the characteristics of the men involved A survey of the data on individual differences led David Wechsler to infer that the democratic assumption that, in so far as participation in government is concerned all men may be considered practically equal is essentially correct C A S Dwight presented data from anthropology and social psychology upon the social and psychobiological significance of ceremony

The Friday morning session was devoted to experimental and theoretical papers A L Windsor and E I Strongin reported an antagonistic action of coffee and tobacco on psychological and physiological processes T L McCulloch found that the learned response of discrimination of an intermediate weight by white rats is partly a function of the absolute magnitudes of the stimuli and partly of the relation of intermediateness, even though the relation was not sensorially present on any one trial Results obtained by C F Scofield showed that the non dominant eye in binocular vision has the greater neuromuscular efficiency H M Johnson and G E Weigand found that, when subjects practised code substitution before retiring and soon after waking, the greater gains occur in the evening and are largely lost during sleep These results led to new hypotheses concerning the nature of physiological impairment and its recovery during sleep According to A R Lauer, a profile of

characteristics will give a better estimate of automobile-driving performance than will any one performance score or general index James P Porter, Ruth Schisler and C E Fiddler obtained average reliability coefficients of 0 487 for the right ear and 0 560 for the left in audiometer tests of school children O R Reiser traced the sources of non Aristotelian logic, stated the thesis of Korzybski and criticized certain of his conceptions

The program of Friday afternoon was a joint symposium with the Section on Education, on theories of learning (Report given by Section Q)

On Friday evening, at a joint dinner with the Section on Education, the retiring vice-presidents of the two sections read their vice-presidential addresses In his address on "Training, Practise and Mental Longevity," W R Miles brought together and interpreted in systematic fashion some of the significant results of work on later maturity W F Dearborn, in his address on "The Mental and Physical Growth of School Children," summarized in an organized picture some of the results of the Harvard growth study

The papers in the Saturday morning session were on child and educational psychology P H Furfey reported that urban boys were consistently superior to rural boys on a developmental age scale John E Anderson found, in an evaluation of four indices of linguistic development, that the indices were of small value for measuring individual performance but were valuable for measuring group differences In a study of 16 cases of extreme linguistic disability in adults Grace M Fernald was able to remove the disability completely by application of kinesthetic methods Comparison of the judgments of two observers is a necessary check on the experimental use of the clinical method, according to the results of T W Richards and O C Irwin V H Noll described a test for measuring scientific attitude and M E Wagner reviewed the methods and results of a how to study course for high school juniors T G Hegge reported positive results from individual training of seemingly untrainable mentally deficient reading cases

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K)

(*Reports from James Ford, Wm F C Nelson, Howard Richards*)

The program for this section was planned largely for a popular audience, inasmuch as economists, statisticians and sociologists were holding their meetings at about the same time in another city The first session, a joint meeting with the Section on Medical Sciences, was devoted to economic and sociological phases of medicine The doctor's point of view on the problem of the cost of medical care was presented by Dr A H Colwell (president elect, Medical Society of Pennsylvania), and the economist's point of view was presented by Dr Michael M Davis (Julius Rosenwald Fund) Miss Dorothy G Wiehl (Milbank Memorial Fund) presented an analysis of recent mortality statistics The concluding paper dealt with the results of a statistical study on the effect of climate on pulmonary tuberculosis, by Alfred Cowles, 3rd (Cowles Commission for Research in Economics) and Dr Edward N Chapman (formerly secretary of the Colorado Foundation for Research in Tuberculosis)

On Saturday, the luncheon session was given over to the statistical record on the progress of world recovery Five speakers discussed the record for, respectively, the United States, England and the British Commonwealth, Germany, the gold bloc nations and the Far East Dr Albert Einstein and the Honorable Henry A Wallace were guests at the meeting Secretary Wallace spoke briefly

Under the general heading Contemporary Economic and Social Problems under the New Deal," five sessions were held on Monday and Tuesday These sessions dealt with the housing problem, problems of economic control, the problem of economic security, problem of the consumer and economic planning At the last named session, Professor Wesley C Mitchell, retiring vice president of Section K, gave his vice presidential address on 'The Social Sciences and National Planning" Professor Mitchell urged the establishment of a permanent national planning board organized for a systematic consideration of social problems and how they may best be solved Carl Snyder gave an illustrated talk on 'The Invisible Hand of Adam Smith," in which he presented the results of his long term measures of economic growth, pointing out the implications of this record in terms of attempts at planning The socialist critique of planning in a capitalistic state was presented by Dr Harry W Laidler, executive secretary of the League for Industrial Democracy

Considerable interest was manifested in the discussions of economic control Assistant Secretary of State Francis B Sayre presented a plea for the restoration of international trade and for the adoption of an American policy in accord with the realities of our position as a creditor nation Assistant Secretary of Agriculture M L Wilson defended the policy of the Agricultural Adjustment Administration, showing how this policy was necessary to restore American agriculture to a position of parity with American industry Professor Edward S Mason (Harvard University) presented a vigorous attack on the administration of the National Industrial Recovery Act, observing that, since the Administration had no program of planning, industry through its trade organizations had been allowed to adopt restrictive measures under the guise of planning His opinion was that it

would be exceedingly difficult to rid the country of this restrictive philosophy because of the vested interest created under NRA. Oswald Garrison Villard (contributing editor of *The Nation*) criticized the Administration's program on social security as nebulous and baffling in its constantly announced changes and made a plea for the adoption of a broad program of social insurance, pointing out the urgency of the problem.

The Econometric Society began its meetings at Pittsburgh with a joint session with the American Mathematical Society, the Mathematical Association of America and the Sections on Mathematics and on Social and Economic Sciences. At this session, which was held on Friday evening, the nature and limitations of statistical proof were considered. (Reported by the Section on Mathematics.)

In a session on Saturday morning, Professor Henry H. Pixley presented a study which showed how rents varied by size of town and by geographical regions. Other papers were presented by Max Sasuly and Dr. L. J. Paradiso.

On Saturday afternoon a joint session with the Section on Engineering was held on the subject, "Cost and Cost Theory." H. J. Titus (the Franklin Railway Supply Company) presented the first econometric study of railway data. He measured the importance of the various factors—mileage between stoppings, horse power, load, etc.—which determine depreciation rates for locomotives. Professor Dexter S. Kimball (Cornell University) presented a paper showing how the industrial engineer could be taught the significance of decreasing cost, diminishing return, etc. He said that many of the engineering failures of the present day might have been avoided if engineers had properly understood cost. Professor Roos gave the concluding paper, which was a study of labor and machine costs. He exhibited statistical studies showing difficulties arising from mandatory shorter work weeks. At the final session of the society, which was held on Saturday afternoon, Walter Keim (National Recovery Administration) presented a series of statistical studies which showed the flexibilities of various prices, magnitude of their responses to monetary developments and the sequence of changes or timing. Discussion of Mr. Keim's interesting paper lasted nearly two hours.

The annual meeting of the Metric Association was held at the Carnegie Institute of Technology on December 27. The program was completed with special emphasis on the following features: (1) *Commercial Standards*. C. E. Johanssen, the eminent authority on gages, and Wm. H. Scheer showed how the various nations had come to agree on a temperature of 20 degrees C. (68 degrees F.) for taking measurements and to accept the international meter as the basis for all linear measures. It was clearly brought out that the measures in customary use in this country are legally and practically based on the metric standards. The services of the International Bureau of Weights and Measures in maintaining the fundamental standards for all nations were highly commended. The change to the practical use of millimeters on the part of the Waltham Watch Company, the DeLaval Separator Company and other American manufacturers was heartily approved. (2) *Chemistry*. Professor J. H. Simons represented the American Chemical Society. He told how the chemists were not only using metric weights and measures but were spreading their use. (3) *Food Values, Calories, Prescriptions, etc.* Men and women interested in food values, dietetics, hospital and medical work discussed the problems involved in a complete change to the metric system. It was generally agreed by the members present that as accurate food calculations are now made in metric terms, labeling and merchandising should correspond to this procedure. This will do away with the confusion caused by the British and United States quarts, which differ from each other by more than 20 per cent., while the liter is the same throughout the world. Professor T. K. Kruse and Dr. Ira Hogg discussed the education of doctors, nurses and pharmacists with reference to the correct use of metric weights and measures. The use of the metric system was shown to be required in modern medicine. (4) *Calculations and Design*. W. R. Work (Carnegie Institute of Technology) spoke on "The Metric Basis for Electrical and Magnetic Units." He pointed out that one reason for the rapid progress of things electrical is their basis on international metric standards. (5) *Engineering*. Professor Stegeman (University of Pittsburgh) pointed out that the present is the best time to arrange for the change to the general use of metric weights and measures. Every year sees standardization more firmly effected by the various metric countries of the world. He heartily approved of American cooperation in such world wide standardization, as this is good for American business and facilitates friendly relations with other countries.

The following officers were elected for 1935: *President*, W. R. Work; *vice president*, Theodore H. Miller; *secretary*, Howard Richards; *treasurer*, James F. Martin. It was decided to resume the publication of *Measurement*, magazine of the Metric Association.

SECTION ON HISTORICAL AND PHILOLOGICAL SCIENCES (L)

(*Reports from Joseph Mayer and Charlotte Feasel*)

With the History of Science Society and the Linguistic Associations meeting elsewhere than in Pittsburgh this year, the sessions of the Section on Historical and Philological Sciences (L) were somewhat

restricted, although the papers submitted were unusually interesting and the number of members present highly gratifying, one session having an attendance of more than sixty

The first session, held on Monday morning, dealt with historical topics having to do with scientific development in Colonial America, with the development of the Copernican system of planetary motion and with bibliographical material bearing upon the development of trigonometry These subjects were presented in three papers, the first by Theodore Hornberger (University of Michigan) He challenged two prevalent notions about Colonial America with respect to scientific achievement, first, that the so called New Science of the seventeenth century did not reach many Americans until well along in the eighteenth, and, second, that the reason for this retardation was the dominance in New England of Puritanism, amounting to a "virtual repudiation of science" Professor Hornberger based his refutation of these notions upon an examination of some 640 books written in the Colonial period by 33 New England clergymen, selecting four outstanding men as representative of the scientific thought of the period The first of these was John Cotton (1585–1652), the author of "A Briefe Exposition upon Ecclesiastes" and other books which give evidence that the bourgeois spirit of Puritanism took account of the utilitarian possibilities of technological improvements instead of being antagonistic to the advance of natural knowledge Next was Charles Morton (1626–1698), whose manuscript 'Physics" showed that the Puritan faith in education favored the spread of science Third, Cotton Mather (1663–1728), through his writings, Brontologia Sacra," 'The Christian Philosopher" and Manductio ad Ministerium," showed that the Puritan idea of the pulpit as an instrument of edification was an important factor in the dissemination of scientific (as well as pseudo scientific) information The fourth writer, Jonathan Edwards, was presented by contrasting his 'Dissertation Concerning the End for which God Created the World" with the 'Exposition upon Ecclesiastes" of John Cotton, which had already been discussed The comparison illustrated how the advance of science forced the most logical of the clergy to build a new metaphysical basis for their religion From a study of these writings of American Puritans, Professor Hornberger concluded that science came early to America, influencing thought in New England from a very early period

Professor Benjamin Ginzburg, in speaking of the scientific value of the Copernican induction, stated that the difference of approach between modern and ancient science was entirely a matter of a shift in an existing system of thought To appreciate this, it is important to understand the method of Copernicus in arriving at his theory, because no new facts were involved in the passage from the Ptolemaic to the Copernican system It has generally been thought that Copernicus adopted his theory because of its mathematical simplicity and that the physical proof for the heliocentric structure of the planetary system was established after his death Dr Ginzburg maintained that there was here no gain in mathematical simplicity, that the real difference was that Copernicus applied mathematical analysis to the astronomical facts in order to arrive at a physical theory of planetary motion while Ptolemy borrowed extra scientific considerations which did actual violence to the facts Copernicus and Ptolemy both concerned themselves with the question of physical order, but the former answered it in modern fashion by separating the approach of science from that of religion, morals and other such disciplines

Professor L C Karpinski pointed out that after the invention of the printing press the progress of science may be followed quite satisfactorily through the works which appeared in print In arithmetic, Eugene Smith's "Rara Arithmetica" gives a remarkably complete list of arithmetical works to 1600, in the geometry of the seventeenth century, Dr F F Kokomoor in *Isis* gives a list somewhat less complete, in general mathematics, the German topical history by Tropfke contains a notable list, but one which it is difficult to use for bibliographical purposes In the early twentieth century, Avon Braunmuhl contributed two volumes in the field of trigonometry which contain a substantial bibliography Professor Karpinski, in concluding, presented a list of text books on trigonometry, based primarily on the large collection of early mathematical works in the University of Michigan Library

The Monday afternoon session was held jointly with the Engineering Section and pertained to the development of science and technology in Western Pennsylvania Professor John W Oliver, of the University of Pittsburgh, presented a general survey bearing upon this subject He stated that aside from the strategic technographic and technonomic position occupied by Pittsburgh, which made it the focus of a seven years' war between France and England two centuries ago, the region possesses an abundance of natural resources in coal, iron ore, oil and a special grade of sand suitable for glass manufacture Early in American history, industries were developed there, and by 1800 iron, glass, nails and leather goods were being fabricated on an extensive scale Along with these industries came other scientific and technological developments In 1812 companies were organized to manufacture chemicals, and one year later a society was formed in the interest of advancing the chemical and physical sciences In fast succession came the

establishment of rolling mills, the manufacture of bromine, the improvement of the electric motor, clock and locomotive and advances in the science of spectroscopy. All these, the district of Western Pennsylvania developed before the Civil War. Since that time it has progressed even more remarkably along technological lines.

F. C. Hanker (Westinghouse Electric and Manufacturing Company) followed Professor Oliver by presenting developments in the electrical industry in Western Pennsylvania. This district, he pointed out, has contributed much to our social, industrial and economic life; power-supply networks through the introduction of the polyphase alternating current system, long-distance transmission through the development of the transformer, industrial induction motors and the steam turbine generating unit.

The final paper of this section, by Professor Harry S. Hower (Carnegie Institute of Technology), presented an interesting survey of the rise of the glass industry in the Pittsburgh district, describing the history, methods and improvements in glassmaking in that region. Special mention was made of astronomical telescopes, searchlight mirrors, lighthouse lenses, special colored glasses and the white diffusing glasses which are of importance in illuminating engineering.

SECTION ON ENGINEERING (M)

(Report from Vannevar Bush)

The activity of the Engineering Section is always severely limited by reason of the fact that the great engineering societies do not hold their annual conventions at the time and place of the association meeting. For this reason the principal benefit to be derived from the Section on Engineering meetings is a closer contact between scientists and those engineers who are present. The program is always adapted as far as possible to be of wide interest among engineering groups in the hope that many of the engineers who are resident will feel called upon to participate.

The principal feature this year was the evening address of the retiring vice-president, Dr. C. F. Kettering, before a large audience in Carnegie Music Hall. Dr. Kettering's address on "Some Future Problems of Science and Engineering" was full of suggestions, as is always the case when he speaks before a group of this sort.

The Engineering Smoker was held at the University Club at the conclusion of Dr. Kettering's address. Although not as largely attended as had been hoped, nevertheless as the first affair of the type ever held for these groups at an association meeting, the results were worth while. Patterned after the smokers which have been so valuable in the biological sections, it brought together scientists and engineers in an informal manner, and resulted in animated discussions in small groups. The physicists, mathematicians and chemists were invited, and it is much to be hoped that when the affair is repeated they will more fully grasp this opportunity to discuss interesting matters with engineers in the field. Dr. C. E. Skinner, chairman of the section, made all the arrangements for these events and presided.

The section had also a program on problems of stress distribution and plastic deformation in metals, held on Saturday morning. That afternoon the section joined with that on Social and Economic Sciences in a program on "Cost and Cost Theory." It also joined with the Section on Historical and Philological Sciences in a program on Monday devoted to the history of interesting technological developments. Joint sessions of this sort have proved well worth while, as they carry out excellently one of the fundamental objectives of the association.

SECTION ON MEDICAL SCIENCES (N)

(Reports from Earl B. McKinley, Albert L. Midgley)

The program of the section consisted of three symposia and one morning and one afternoon general session. Symposia were held on the mornings of December 27, 28 and 29 on "Poliomyelitis" and "The Chemistry and Metabolism of Sulfur-Containing Compounds of the Body." Papers dealing with general subjects were presented during the morning and afternoon sessions held on December 31.

At the symposium dealing with the poliomyelitis problem on Thursday morning Dr. Maurice Brodie (Department of Health of New York City) described the newer developments in connection with the production of active immunity against this disease. This group of investigators, during the past year, has prepared a vaccine which, when administered to experimental animals or to man, leads to the production of active immunity against the virus of this disease. This vaccine consists of the virus of poliomyelitis obtained from the infected spinal cord tissue of monkeys and treated with 0.1 per cent. formalin. Ten per cent. virus emulsion treated with 0.1 per cent. formalin seems to be the best. Of this vaccine five cubic centimeters are employed as an immunizing dose. Monkeys susceptible to this virus can be successfully immunized with this formalized tissue-virus suspension, and Dr. Brodie described recent experiments in which the vaccine had been administered to a series of 35 children and it was found that protective anti-bodies were produced within one week and reached their height within four weeks.

Similar studies on vaccination against the virus of poliomyelitis were described by Dr. John A. Kolmer (Philadelphia). His method is an elaboration and adaptation of a method originally described in 1927 by McKinley and Larson, who first treated poliomyelitis infected spinal cord tissue of monkeys with sodium ricinoleate, and with virus treated in this

manner these authors were able to successfully immunize completely three monkeys and one partially following intraperitoneal injections of the vaccine Dr Kolmer and Miss Rule described their more detailed experiments with this method and presented convincing evidence of the authenticity of their results This vaccine has been employed in monkeys and also in a group of twenty five children without ill effects, and Dr Kolmer stated that protective antibodies were produced successfully Contrary to the work reported by Brodie, in so far as dosage is concerned, Dr Kolmer states that small doses of the vaccine as prepared by him, such as one half to two cubic centimeters, are sufficient for immunization One to three of such doses are administered

In addition to these two interesting papers on vaccination against poliomyelitis Dr W Lloyd Aycock (Harvard University) presented a paper on 'The Application of Hereditary Factors in Poliomyelitis to the Study of Autarkiologic Susceptibility" This paper was followed by a presentation on 'Experiments on the Specificity of the Neutralization Reaction in Poliomyelitis' by Dr N Paul Hudson (University of Chicago) By studying adsorptive properties of the neutralizing factor of "normal' and convalescent human serum to alumina gel Hudson states that adsorption was effected at pH 6 5 and elution at pH 7 4

The last paper in this symposium was presented by Randall L Thompson and Dr Earl B McKinley (George Washington University), who reported the successful immunization of monkeys to poliomyelitis with *very minute* doses of live, unattenuated, poliomyelitis virus when mixed with the active virus of vaccinia and injected intracutaneously

An unusually interesting symposium was held on Friday and Saturday mornings on The Chemistry and Metabolism of Sulfur containing Compounds of the Body" and their relationship to various medical problems, such as cancer, arthritis, muscular dystrophy and cystinuria The symposium was opened with an introductory discussion by Professor H B Lewis (University of Michigan), who reviewed the chemistry of the sulfur compounds to be discussed during the symposium Professor Lewis then noted recent developments in knowledge of the intermediary metabolism of cystine, cysteine, methionine and homocystine and the interrelationship of these compounds Dr Erwin Brand (New York State Psychiatric Institute) presented various experiments with cystinurics, he brought out the fact that methionine, homocysteine and cysteine yielded cystine in cystinurics, whereas homocystine and cystine did not The central rôle that glutathione may possibly play in the various detoxication reactions of the body was also discussed The fate of methionine in cystinurics was treated by Professor J C Andrews (University of Pennsylvania) He presented, in addition, some interesting studies on the adsorption of cystine and various of its derivatives from intestinal loops of dogs Then came a very stimulating paper by Dr Ben H Nicolet (Department of Agriculture), in which he presented a novel mechanism for the synthesis of methionine by plants, based on the addition of methyl mercaptan to methylene pyruvic acid

The first two papers on the second day program emphasized the rôle that sulfur compounds may play in cancer, although both papers were also of much significance from the standpoint of normal growth of tissues In the first, Dr Frederick S Hammett (Lankenau Hospital) discussed the influence of sulfhydryl on cell proliferation and its possible significance in the cancer problem The effect of the equilibrium between sulfide and sulfhydryl on protein synthesis and degradation was discussed by Dr Carl Voegtlin (National Institute of Health) Anaerobic conditions were observed to favor proteolysis in tissue extracts, whereas under high oxygen tension proteolysis was inhibited A greater sulfhydryl concentration was found in the anaerobic digests This and other experiments indicated that the enzyme contains a reversibly oxidizable group, which in its oxidized state favors degradation and in its reduced state synthesis After the presentation of these papers relating to cancer, Dr M X Sullivan (Georgetown University) presented his findings with respect to the change in cystine content of the finger nails in arthritis The cultural requirements of bacteria, particularly from the standpoint of methionine and cystine, were reported by Dr J Howard Mueller (Harvard University) Both amino acids seem to be necessary for normal growth of bacteria in contrast to that of animals where it appears that either cystine or methionine will suffice The symposium was closed by a discussion of the significance of sulfur to the chemistry of insulin and the post pituitary hormones by Dr du Vigneaud (George Washington University)

On Friday afternoon a joint session was held with the Section on Social and Economic Sciences on "Economic and Sociological Phases of Medicine" (Reported by Section K)

On Monday, many papers on a wide range of subjects were presented Dr Andrew Wallhauser (University of Pittsburgh) discussed fungous organisms in medical diagnosis and pointed out the necessity of an intimate correlation of the clinical picture and mycological study of this group of organisms Dr R C Grauer and Dr G H Robinson (Singer Research Laboratory) described two spontaneous mammary adenomas in white rats which were transplanted through eight generations and over a period of five years Two papers dealing with different phases of the leprosy problem were presented, the first by Dr

Frederick P Gay (Columbia University), who spoke on "Unsolved Problems of Leprosy" He discussed the question of segregation of lepers, the infection of children with this disease, segregation of children from leprous parents at birth, the present status of the etiology of the disease and the question of specific therapy in the disease The second paper was on "The Relationship of Human Leprosy and Rat Leprosy, a Study of Wild Rats Captured in the Culion Leper Colony," by Malcolm H Soule (University of Michigan) Soule presented convincing evidence that, under natural conditions on the Island of Culion where thousands of lepers live, the wild rats do not develop the disease Leland W Parr (George Washington University) spoke on 'The Succession of Colon Aerogenes Forms in Stored Feces and its Significance for Sanitation and Pathology" and concluded that the variation in forms met with in his study is from the deficiency imposed by the conditions of storage and would not appear to be the arising *de novo* of a new form Ruth R Puffer (Tennessee State Department of Health) discussed the subject of "The Effect of the Distribution of Medical Service on Vital Statistics Data as Shown in Tennessee" and observed that the cleavage in the vital statistics data in urban and rural areas is great and is directly dependent on the distribution of the medical service Dr George L Waldbott (Detroit) described a study on "So called Thymic Death in the Light of Recent Investigations on Allergic Shock" and concluded that the so called thymic constitution is identical with the allergic make up A paper on "The More Newly Recognized Causes of Sudden Heart Attacks" was presented by Dr Louis F Bishop (New York City) Dr F C Messer and Dr R H McClellan (St Margaret Memorial Hospital, Pittsburgh) presented two papers dealing with their recent studies on the use of blow fly maggots in the treatment of osteomyelitis wounds Dean Charles B Lipman (University of California) presented an important paper on his more recent studies concerning the longevity of bacteria His studies would indicate that living bacterial forms are to be found in old soils stored in sealed containers from 25 to 65 years, that similar forms are to be isolated from adobe bricks removed from the interior of the walls of the California missions which are 112 to 150 years old, that bricks or consolidated mud from the Pueblos in Arizona (about 600 years old), bricks from the pyramids of Lima, Peru (about 1,400 years old), and from the pyramids in Mexico (1,000 years old) all contain similar bacterial forms which may be isolated on suitable laboratory media

Monday afternoon several other papers were presented Matilda M Brooks (University of California) spoke on "The Mechanism of Methylene Blue Action in CO and CN Poisoning" John H Hanks (George Washington University) presented a paper on "The Mechanism of Tuberculin Hypersensitiveness" and concluded that definite bacterial factors other than the sensitizing proteins are responsible for the production of the tuberculin type of hypersensitiveness This was followed by a paper entitled "Demonstration of New Toxic Substances in Tuberculosis" by Dr Gregory Shwartzman (Mount Sinai Hospital, New York City) who described new substances in tuberculin O T and B *tuberculosis* culture filtrates which were capable of eliciting the hemorrhagic necrosis of the phenomenon of local skin reactivity, provided heterologous bacterial filtrates of high potency are used either for the intradermal or intravenous injection Dr Louis A Julianelle (Washington University, St Louis) presented a paper on Studies on the Infectivity of Trachoma" He stated that the constitution and faulty or defective diet may be eliminated as causes or accessories in this disease, that trachoma is a local disease, that trachoma is infectious for monkeys, that it is not possible to transmit the disease to normal monkeys with organisms cultivated from lesions of the disease, that the infectious agent does not pass through Berkefeld filters in sufficient quantities at least to cause infection and that attempts to correlate infectivity of a given material with the presence or absence of the epithelial cell "inclusions" have been fruitless A paper on 'Recent Studies on Endemic Typhus" was presented by Dr R F Dyer (National Institute of Health, Washington, D C), who stated that a reservoir of endemic typhus exists in nature in wild rats, that the disease is transmitted from rat to rat and rat to man by ectoparasites of the rat, that the rat flea, *Xenopsylla cheopis,* is probably the vector from rats to most of the human cases, that this flea is readily infectible experimentally and multiplication of the virus takes place in the flea, increasing several thousand fold in a few days Dr Dyer further stated that the disease is readily transmitted by the flea under experimental conditions Further studies in immunity were reported by Dr Reuben L Kahn (University of Michigan), who stated the theory that the capacity for defensive responses to microorganisms has been developed by animals in their struggle for survival against these microorganisms through evolutionary ages

At this point the section expressed its deep regret at the recent death of Dr Allan Winter Rowe (Evans Memorial Hospital, Boston), who was to have presented a paper in this program

Alden F Roe (George Washington University) presented a paper on "Preserving Anaerobes by Desiccation" and showed that by his method of drying cultures all the aerobes in his experiments remained viable and most (98 per cent) of the anaerobes remained viable after storing in a dry state for one year Dr R H McClellan and Dr F C Messer

(St. Margaret Memorial Hospital, Pittsburgh) spoke on "Investigative Difficulties with Experimental Animals with Special Reference to Histo Pathological Changes in the Liver" The final paper at this session was presented by Dr Seth T Walton (Health Department, Charlotte, N C), who spoke on "Studies on the Specific Characteristics of Syphilitic Blood Proteins"

For the third successive year the dental profession was represented actively in the affairs of the American Association through a program offered under the auspices of the American College of Dentists The meeting opened with a very satisfactory attendance which was in excess of previous meetings

At the morning session Dr James L Zemsky (New York City) with the use of lantern slides discussed "Further Study of Roentgenographically Negative Submerged Roots" Dr J Oppie McCall (Guggenheim Dental Clinic, New York City) delivered a paper entitled 'The Modern Search for the Philosopher's Stone," which was illustrated by lantern slides Dr John S Oartel (Pittsburgh) spoke on Morphological Changes of Bacteria Induced by Ultra Short Wave Radiation" A discussion entitled "Changes in the Dental Pulp and Surrounding Calcified Tissues," illustrated by lantern slides, was offered by Dr Warren Willman (Chicago) 'The Tripping Action of Bar Clasps—A Comparative Physical Analysis of Retentive and Stabilizing Functions of Clasps," amplified by the use of a lantern, was presented by Dr Eugene R Stone (Washington, D C) A presentation, "Rootless Teeth,' by Drs E G Meisel, J C Eselman and W F Swanson (University of Pittsburgh Dental Faculty) then engaged the attention of the audience

In the afternoon a paper on "Motion Picture Studies of the Eruption of Teeth and Developmental Growth of the Face," illustrated by lantern slides, was presented by Dr B Holly Broadbent (Cleveland) Dr L E Blauch (American Association of Dental Schools, Chicago) discussed "The Changing Dental Curriculum" Because of the present status of the dental curriculum Dr Blauch's presentation was received with much interest and proved quite instructive Dr Raymond J Nagle (Boston) offered a treatise of timely concern to the modern dental practitioner He spoke on "Galvanism in the Mouth" "A Precise Quantitative Roentgeno Densitometric Study of the Changes in Teeth Due to Attrition" was presented by Dr Grant van Huysen (Rochester, N Y) Dr Basil G Bibby (Rochester, N Y) spoke on, and illustrated with the use of a lantern, "Variations in the Nature of the Enamel Surface" Dr H E Friesell then read a paper prepared by Dr John L. Boots (Seoul, Korea) on "A Chinese Skull of the Second Century" A delightful informal dinner was held at 6 30 P M at the University Club

It is heartening to all actively interested in the new relationship to find a growing sense of responsibility on the part of our dental schools, educators and scientists in the solution of dentistry's problems, especially those pertaining to its biological phases—so closely related to good health The program presented brought a realization that dentistry is no longer solely concerned in developing the mechanical aspects of its procedures That older idea has been displaced by the newer effort to discover the nature of conditions, factors and influences that maintain health, that induce deficiency, or that afford the most effectual means to prevent, control or to cure disease

SECTION ON AGRICULTURE (O)

(*Reports from P F Brown, R P Thomas, H B Tukey, Wm H Martin*)

The program arranged by the section consisted of a symposium on 'Agricultural Planning," held in conjunction with the American Society of Agronomy and other affiliated societies on Friday, with an attendance of about eighty The subject was opened by Dr A R Mann, retiring chairman of the section, who discussed the agricultural significance of state and national planning in all its broad economic and social aspects A paper by Dr C F Marbut pointed out the necessity for land inventories and land classification as a basis for a planned agriculture, and H H Bennett emphasized the importance of erosion control in any plan for the future Director V R Gardner called attention to the very specific problems which are involved in a consideration of a planned production as applied to tree fruits, and F A Silcox (Forest Service) presented a picture of the place which forestry must fill in future planning Assistant Secretary of Agriculture M L Wilson discussed the administration views and plans for a balanced agriculture, in so far as these plans have been developed E N Wentworth (Armour's Livestock Bureau) called attention to the difficulties of the packers and their views of the planning program Gerald B Thorne (Agricultural Adjustment Administration) discussed the livestock problems which must be met and solved for a safe and sound plan C D Jackson (Bureau of Agricultural Economics) and P A Herbert (Michigan State College) presented the problems of taxation changes in relation to farm lands and forest lands, as affecting the development of a sound agricultural plan The discussion by Secretary Wilson and others indicated that there is a general recognition of the fact that planning agriculture for the future must be most wisely and carefully done, with full consideration of the many variable factors involved

The Northeastern Section of the American Society of Agronomy and the Potato Association of America held a joint session on Saturday morning Dr J G. Lipman discussed the social and economic factors

relating to land use planning in the northeastern United States. The changes in population produced different types and kinds of farming than developed by the early settlers. It is doubtful if the use of machinery has reached its maximum for the greatest efficiency. If properly managed the commercial or corporation type of farming should be profitable in this section.

B. E. Brown reported the results of cooperative fertilizer tests with white potatoes. The average of three years' results in Virginia, New Jersey, New York, Ohio, Michigan and Maine showed that fertilizer placed in a band at the side of the potato seed was superior to be usual manner of fertilization. Professor J. S. Owens described the development of agronomic extension work from the experiment station research and teaching. Now the extension work is handled by a specialist who is too busy to keep up with the research and teaching problems. Dr. C. H. Myers discussed the coordination necessary between the research and extension agronomists. By necessity the work of the research worker precedes. But the number of people engaged in extension work and the money expended is greater than for research. As a result, new work is oftentimes passed out to the farmer before it has been sufficiently tested by the research man. On the other hand, the research worker is apt to submerge his findings or be very slow in passing them on for practical use. This could be best overcome by having the two classes of workers closely associated. Dr. E. Van Alstine discussed the many problems which the extension specialist, particularly the county agent, has to meet. Owing to the demands made upon these workers they can not make detailed tests or supply detailed information; they have to depend upon the extension service and experiment station for this information.

Saturday afternoon a symposium was held on the use and application of rapid soil tests. Professor S. D. Conner reported that lime, phosphorus and potassium tests were made upon the Indiana soils. Instructions for making these tests are given to any county agent or vocational agriculture teacher who desires such. The county agent is not encouraged to make the tests himself. The agronomy department at the university tests all soil samples received. Dr. F. G. Merkle discussed the use of rapid chemical tests on Pennsylvania soils. He reported results with a pH 5 sodium acetate solution. On the extracts of the soil with this solution calcium, potassium, aluminum, phosphorus, magnesium and manganese estimations are made. These tests are not recommended for county agents or similar workers. Dr. J. B. Hester reported the results of rapid soil tests on vegetable and truck soils of Virginia. He is using a pH 5 sodium acetate solution for extracting the soils. These tests are made at the experiment station and have saved the farmer many thousands of dollars. Dr. R. P. Thomas pointed out that the rapid chemical tests used on Maryland soils were a modification of Morgan's method. It is recommended that the samples be sent to the university for testing. These tests do not take the place of the fundamental soil research, though their use gives valuable information for making fertilizer recommendations.

The thirty-first annual meeting of the American Society for Horticultural Science was held in four sections, including a joint session with the American Society of Plant Physiologists and a joint session with the Potato Association of America. There were 186 papers presented, representing the largest number in the history of the organization. The general trend of research in horticultural problems continues largely along the lines of physiology. Among the topics of major interest were those of photosynthesis as affected by various field factors, the effect of external stimuli upon sex reversal in plants, soil moisture relations, the movement of water in the soil and throughout the growing plant, physiological problems of nut trees, developmental morphology of fruits and vegetables, limiting elements as factors in physiological disease, fruit-tree rootstocks, photoperiodism as affecting floricultural crops, ripening processes in fruits and vegetables and breeding of horticultural crops.

The address of the retiring president, Dr. J. R. Magness (U. S. Department of Agriculture), reviewed the relation of fruit trees to soil moisture. Director H. H. Zimmerley (Virginia Truck Crops Experiment Station) was elected president for the year 1935.

The twenty-first annual meeting of the Potato Association of America included a joint session, on Friday afternoon, with the American Society for Horticultural Science and one on Saturday morning with the Section on Agriculture and the Northeastern Section of the American Society of Agronomy.

Reporting on the effort being made in Canada to stabilize the potato industry, J. R. Tucker stated that very wide powers are included in the Natural Products Marketing Act of 1934, with a view to improving the methods and practises of marketing of natural products in Canada. Under this act, local boards may be set up; these boards do not actually market the product, but may regulate the marketing through channels already in operation, or otherwise, and may license dealers, register the growers, collect tolls, etc. It is intended that the scheme shall be entirely self-supporting. H. B. Tabb and H. G. Zuckerman discussed possible means of regulating the potato industry in the United States. Kris P. Bemis reported on the potato marketing agreements now being considered by certain of the southern states. A committee was appointed to work with other agencies in an attempt

to formulate a plan for the regulation of the potato industry

The following officers were elected *President*, J B R Dickey (State College, Pennsylvania), *vice president*, F J Stevenson (U S Department of Agriculture), *secretary treasurer*, Wm H Martin (New Jersey Agricultural Experiment Station)

SECTION ON EDUCATION (Q)

(*Report from William S Gray*)

The opening session of the program was held jointly with the Section on Chemistry and the Division of Chemical Education of the American Chemical Society The central theme was The Rôle of Chemistry in Education" It is reported by the Section on Chemistry

The second session was devoted to reports of various investigations relating to reading A paper by G A Yoakam (University of Pittsburgh) showed that distinct progress has been made during recent years through research concerning the nature of study, the procedures adopted by pupils at different levels of advancement, and to some extent the relative effectiveness of these procedures The possibility of improving the reading habits of children and adults was clearly demonstrated in the case of poor readers in public schools by Joseph Zubin (College of the City of New York) and in the case of college students by A R Lauer (Iowa State College) The rapid progress which is being made in the development of scientific techniques for use in diagnosing reading disabilities was emphasized by E A Betts (State Normal School Oswego, New York), who described various visual tests which may be given through the use of telebinoculars, an adaptation of the stereoscope Some of the factors which make for difficulty in reading materials for adults of limited education were discussed by William S Gray (University of Chicago)

The joint session with the Section on Psychology was of peculiar interest to the members of both sections, being a symposium on psychological theories of learning In discussing cortical dominance and learning, Mandel Sherman (University of Chicago) presented evidence showing that sub-cortical dominance prevails in the case of very young children Gradually, however, cortical dominance is attained Fundamental distinctions between the Gestalt and other theories of learning were discussed by Robert M Ogden (Cornell University), who emphasized particularly the fact that the Gestalt psychology is concerned with behavior patterns which are fully integrated units J F Dashiell (University of North Carolina) described three general types of learning, namely, the trial and error method, the conditioned response type and the Gestalt doctrine He then presented ten common principles involved in experiments these three fields, thus attempting to synthesize the learning theories involved The final paper by Clark L Hull (Yale University) made a plea for a more careful checking of hypotheses as a desirable means of extricating psychology from the conflicting theories which it now faces

In harmony with the practise of other years, the program following the joint dinner with the Section on Psychology was limited to addresses presented by the retiring vice-presidents of the two sections This program is reported by the Section on Psychology The last two sessions were devoted to brief reports of scientific studies from members of the Section on Education The studies varied from the survey of type of investigation to carefully controlled laboratory experiments The wide variety of problems presented was impressive, indicating that practically every important phase of education is being studied to day, critically and objectively

ORGANIZATIONS RELATED TO THE ASSOCIATION AS A WHOLE

(*Reports by Jennie Hall Edward Ellery, H R Nelson, Agnes Z Hill*)

The American Nature Study Society opened its program on Thursday morning with a paper by Philip J Hickey, showing how federal aid might serve to develop adult education Nature and science education for the young of all levels was discussed in six different round tables Dennis Cooper illustrated the work being done in the field of living things in the Detroit schools Junior and senior high school were separately discussed under the leadership of Gordon Gillen and J C Amon (Pittsburgh) while discussions of Outdoor Activities" and of Teaching of Science Method" were guided by Wm G Vinal and E V Morrison and discussion of 'Research and Curriculum Construction" was led by George Green, at which meeting a report of progress of the research committee was given by Florence Billig The program on Friday consisted of six addresses given by outstanding men in fields of science, who illustrated cycles of change in life and physical conditions They were J LeRoy Kay, J H Bradley, Jr, Henry Leighton, George D Fuller, Wm S Cooper and Samuel H Williams

On Thursday evening a large group attended a dinner and an illustrated lecture by H C Bryant on the scenery of the Florida Everglades An excellent exhibit illustrating the work of the public schools of Pittsburgh was arranged and displayed in a room adjoining the meeting rooms by John A Hollinger and his staff

Sigma Xi held its thirty fifth annual convention on Friday afternoon Delegates were present from forty-six of the sixty four chapters, this being the largest representation of chapters at a convention of the society since 1928 Important items of busi-

ness were transacted as follows The alumni committee reported contributions to the amount of $1,500 for grant-in aid of research for 1935-36 The semi centennial committee reported that the semi centennial of the society would be celebrated in Ithaca in June, 1936, and that the program would consist of a history of the society during the last fifty years, an address on the accomplishments and future of the physical sciences, an address on the accomplishments and the future of the biological sciences and an address on the relation of science to the progress of human society, that the Cornell Chapter will entertain all the delegates and guests at a complimentary dinner, and that the society will publish a half century record and history similar to the quarter century record and history published in 1911 Charters for chapters were granted to Smith College in Northampton and Wesleyan University in Middletown, Conn

Professor Dayton C Miller (Case School of Applied Science) was elected a member of the executive committee for the ensuing five years, and C E Davies (secretary of the American Society of Mechanical Engineers) was elected a member of the alumni committee for the same period

The Gamma Alpha Graduate Scientific Fraternity held its annual council meeting and convention on Friday and Saturday Discussion of matters of policy centered around the report of a committee which has been investigating ways and means of increasing the usefulness of the fraternity to its members and to science in general The report stressed the opinion of university presidents, deans of graduate schools and well known scientists that the organization occupies a unique position among scientific societies and plays a valuable rôle in the various universities which have chapters H R Nelson (Battelle Memorial Institute, Columbus, Ohio) was elected president and Professor Scott Mackay (University of Wisconsin) secretary

Sigma Delta Epsilon, graduate women's scientific fraternity, held its annual business meeting on Thursday at which the following officers were elected *President,* Helen Jean Brown (Ohio State University), *vice presidents,* M Helen Taylor (University of Illinois), Mrs Zonya Wallen Lawrence (University of Chicago), *secretary,* Margery C Carlson (Northwestern), *treasurer,* Marion L Dawson (Cornell) At the breakfast for women in science given on Saturday at the College Club, Miss Lucy Boyd spoke on "Women in Science in Scotland" Mrs Leon H Hetherington (Pittsburgh) made local arrangements and contributed much to the success of the meetings

REPORT OF THE COMMITTEE ON GRANTS

Of forty one applications considered, nineteen were approved by the committee The following table gives the names of the applicants, their addresses and the sum determined upon in each case by the committee

H W Anderson, University of Illinois	$ 425 00
Wallace R Brode, Ohio State University (Provided, that the balance needed to purchase the spectrograph be raised by June 1, 1935)	200 00
Mrs Betty Watt Brooks, Carnegie Museum, Pittsburgh	75 00
Laurence M Dickerson, Lebanon, Tenn	100 00
Carroll L Fenton and Mildred A Fenton, West Liberty, Iowa	100 00
Frank G Hall, Duke University	200 00
Roy Hertz, Howard University Medical School	75 00
LaDema Mary Langdon, Goucher College, Baltimore Md (for supplies only)	50 00
Charles J Lyon Dartmouth College	50 00
Arthur H Steinhaus, George Williams College, Chicago, Ill	250 00
Arnold A Zimmermann, University of Illinois, College of Medicine	200 00
Elizabeth Dyer, Women s College, University of Delaware	110 00
Ernest A Spiegel, School of Medicine, Temple University	200 00
Allan C G Mitchell, New York University	100 00
George S Avery Jr, P R Burkholder and H B Creighton Connecticut College (Provided, the glass filters are secured on or before June 1, 1935)	265 00
Reginald D Manwell, Syracuse University	100 00
Herman D Jones, Alabama Polytechnic Institute (Provided, this sum be used only for supplies, and not for salaries)	200 00
Ronald F MacLennan, State College of Washington	200 00
David I Abramson, Long Island College of Medicine	100 00
Total amount allotted to 19 applicants	$3,000 00

The report, signed by Carl E Guthe, acting chairman, Committee on Grants, was on recommendation of the executive committee approved by the council

FUTURE MEETINGS

Dates and places for future meetings have been arranged and announced as follows

Minneapolis, Minnesota, Monday, June 24, 1935, to Saturday, June 29, 1935

St Louis, Missouri, Monday, December 30, 1935, to Saturday, January 4, 1936

Rochester, New York, summer, 1936, with Semi-Centennial of Sigma Xi at Ithaca, N Y, on one day

Washington, D C, Monday, December 28, 1936, to Saturday, January 2, 1937

Denver, Colorado, summer, 1937 Joint meeting with Southwestern and Pacific Coast Divisions

Indianapolis, Indiana, Monday, December 27, 1937, to Saturday, January 1, 1938.

SCIENCE

VOL. 81 FRIDAY, FEBRUARY 8, 1935 No. 2093

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE HUMANIZING OF SCIENCE[1]

By HARVEY CUSHING, M.D.

NEW HAVEN, CONN.

IN the prefatory chapter of Dr. George Sarton's monumental undertaking,[2] there occurs the following statement: "The History of Science, being a new discipline, is not yet well organized or well circumscribed and attracts the attention not only of experienced scholars but of amateurs, dilettanti and cranks."

From which of these categories I have been elevated to this position of prominence I hesitate to enquire. It certainly was not from the ranks of experienced scholarship, nor have I any pretence even as an amateur historian. Though long active in what is said to be a scholarly profession, yet I would be put to it to tell just where the technique of medical practice—the art of medicine—leaves off and the science of medicine begins.

Both are essentially "humanistic" in its wider sense, in so far as the one is directed toward the alleviation of the diseases to which mankind is heir and the other toward their ultimate banishment. The chief difference between modern science and the natural philosophy of the ancients is said to lie in our greater inclination to put things to the test of experiment; and while medicine is constantly broadening its scientific background, in a certain sense every drug a doctor administers and every operation a surgeon performs is experimental in that the result can never be mathematically calculated, the doctor's judgment and the patient's response to his prescriptions being variables indeterminable by any law of averages. But this is far from making medicine a scientific calling.

That admission being made regarding the only subject with which I can claim familiarity, I must at once confess that I do not clearly perceive just where the humanities leave off and science in general begins, nor why in the schools any conflict should have arisen between them, for they spring from the same hellenic roots and seem so essentially supplementary.

Naturally on the part of teachers there is constant elbowing for the curricular recognition of their subjects and with energetic leadership emphasis from time to time may shift in one direction or the other.

[1] Presidential address before the History of Science Society, Washington, December 28, 1934.

[2] "Introduction to the History of Science." Carnegie Institution, Washington, 1927, Vol. I.

Thus at Oxford, the humanities have so long received the greater attention that one easily forgets the presence there in the thirteenth century of Michael Scotus, of Sacrobosco, of Robert Grosseteste, of John Peckham, and above all of Roger Bacon with his dictum: *Sine experientia nihil sufficienter scisi potest.* Then again in the seventeenth century under Wilkins, Boyle and Wren, Lower, Willis and Hooke, natural science was so ardently cultivated at Oxford that the Royal Society had its inception there. In Cambridge, on the other hand, the physical sciences since the time of Newton have been increasingly emphasized; and this same tendency now so far pervades most universities in our own country that the number of undergraduates who major in the classics appears to be constantly dwindling.

Yet those who ultimately take up whatsoever branch of science without some preliminary schooling in Latin and Greek unquestionably suffer a handicap. This is true, among many other reasons, in that our scientific terminology is almost wholly based upon these two languages; and consequently the special lingo that must be acquired, if not meaningless to the tyro without them, at least loses much of its real significance, flavor and interest. What is more, since the early scientific treatises were written in the same languages that constitute the *Litterae Humaniores,* there would appear to be no essential reason, apart from the subjects with which they happen to deal, why from a classical standpoint they are not as humanistic as what used to be called "polite letters."

All this goes to show that I do not know precisely what, if anything, the humanities have to do with humanism, or just what humanism is unless it concerns itself with the philosophy of man whereas the physical sciences deal with the philosophy of his environmental matter—what Professor Dewey would call Naturalism.[3] But the old-time natural philosophy went out—proudly, be it said—with the comprehensive "Kosmos" of the aged Humboldt, whose death, curiously enough, coincided with the appearance of "The Origin of Species" which may be looked upon as the beginning of the modern era of science with its wholly altered conception of man's place in the universal scheme of things.

The term "scientific" in these modern days has come to be much abused. Many things that are popularly looked upon as being scientific, and many persons who are said to look upon life from a scientific point of view are no more scientific than an infant in its cradle, however much the child is in process of being brought up on so-called scientific principles with a pediatrist on one side scientifically to measure its vitamins and calories day by day and a psychologist on the other scientifically to protect it from complexes—perhaps even to provide an infant chimpanzee as a comparative playmate. Thus does the quasi-science of medicine sometimes lead to absurdities from which medical practice, largely controlled by common sense, usually escapes.

It is ridiculous that a doctor should be regarded as "scientific" merely because, having recourse to a few instruments of some considerable precision, he supplements his sensory impressions thereby, possibly puts a few of his observations or conjectures to the test of experiment and finally writes a paper or two on his deductions. He may even awake some day to find his name starred in "American Men of Science" when in his heart he knows that his supposedly scientific observations have been either disproved or reinterpreted almost before their appearance in print, whereas his true learnings are humanistic. At least he likes to think his instincts are humanistic—shall I say scholarly?—and yet, while so flattering himself, he is conscious of some uncertainty as to what, after all, the term really signifies. He is quite familiar with humanity—knows it, in fact, stripped to the skin—and his code of ethics emphasizes the Christian principles of philanthropy; but "humanism" appears to be something entirely different. It has become a word people conjure with.

Even after reading Irving Babbitt,[4] so bewildered have I found myself regarding the implications of the term I have felt obliged to seek aid from a scholarly friend and colleague. His interpretation, it appears, is restricted to the last of the four definitions given in 1901 by Gilbert Murray and his collaborators, *viz.:* a devotion to those culture-promoting studies, especially the Roman and Greek classics which came in vogue at the Renaissance. Insisting that this is in accordance with the usages of Varro and Cicero, my friend cites Aulus Gellius to the effect that *humanitas* in Latin is *not* φιλανθρωπια which is defined as *benevolentia erga omnes homines,* but that people who knew Latin and used it well "humanitatem appellaverunt propemodum id quod Graeci παιδειαν vocant, nos *eruditionem institutionemque in bonas artes dicimus. Quos qui sinceriter percupiunt ad petuntque, hi sunt vel maxime humanissimi.*"

Thus it would appear that even during the lifetime of Galen there may have been a tendency, against which Gellius protested, for the word *humanitas* to imply something more than literary culture just as in our own time, on the authority of the New English Dictionary, humanism more properly signifies a "de-

[3] John Dewey, "Humanism and Naturalism." Monroe's Encyclopaedia of Education.

[4] "Humanism: an Essay at Definition." Essays on the Outlook of Modern Civilization. Edited by Norman Foerster, 1930.

votion to human interests" or "the character and quality of being human" which comes very close to a concern for man's well being on the one hand, and to φιλανθρωπια on the other

I have gone into all this because of my somewhat enigmatic title 'The Humanizing of Science' which may mean one of two things—(1) a revival of interest in the early classics that deal with natural philosophy, and (2) such an enlargement of the scientific outlook as to include in its scope matters which have to do with human welfare as something apart from culture and in the long run perhaps more important

While a revival of appreciation for the literary and historical classics chiefly characterized the Italian born humanistic movement of the Renaissance, it should not be forgotten that contemporary mathematicians and astronomers were for their special purposes finding the early classics of science no less remarkable and important as sources of learning But the scientifically minded among the scholars of the day represented, as always, a minority and it was natural enough that the larger group, through the wider appreciation and understanding of the subjects with which they dealt, should have come to be regarded as the more cultured

As typical representatives, the names of Erasmus and his English friends, More, Colet, Latimer and Grocyn, quickly come to mind and, among doctors, perhaps more particularly the name of Linacre, *philosophorum medicorumque facile princeps*—with the futile wish that one might have possessed some of his scholarly gifts

While Linacre is said to have made his Latin translations of Galen from Greek codices in the Vatican, they were already well known through Muslim transmitters whose texts, though used in all the schools, were coming into disrepute as supposedly barbaric Nevertheless, Albertus Magnus, according to Renan, owed everything to Avicenna as did St Thomas Aquinas almost everything to Averroes, so possibly even Linacre in collating his Galenic texts may have had reason to lament his want of familiarity with a language which was of little use to the Renaissance students of history and literature The Islamic scholars thought more of Hippocrates than Homer and were far more interested in the mathematics and natural philosophy of the Greeks than in their literary writings

Of the seven liberal arts required for a doctorate those composing the *trivium* were probably more useful for a prospective doctor of medicine than were arithmetic, geometry, astronomy and music—the four mathematical disciplines of the *quadrivium* Medicine consequently, though slow in being regarded as one of the learned professions, attracted during the Renaissance many humanistic scholars scarcely less notable than Linacre Physic was taught as a branch of philosophy, and the ancient learning, though presented in the tongue universal to scholars of the day, was largely what the industrious Hunayn and others, copying from Greek codices, had passed along, in course of time to be laboriously set over from Arabic into none too good Latin

The hand of Aristotle with the commentaries of Averroes lay heavy on philosophical thought for a period of four centuries, but the fact that the peripatetic teachers of the Lyceum were keen observers and had dipped so deeply into mathematical, physical and biological subjects that their era may well be looked upon as 'the heroic age of science,"[5] has been all too much neglected by humanistic scholars of recent times

The value of Greek and Latin as a cultural discipline began to be undermined so soon as the exercises —as many of us to our sorrow remember—began to be largely philological and pedantic in character But over emphasis on classical learning even during the Renaissance sometimes led to absurdities, as when in Toulouse and elsewhere there developed a Ciceronian cult against whose pompous style in writing and diction Erasmus winged one of his barbed shafts It however was dangerous to be too knowing and to express ideas that might be taken as adverse to the accepted dogmas of the church even when couched in the Ciceronian style which Dolet cultivated

And if this was true of the literary humanists, persecutions for heresy were far more likely to strike at those who dabbled with science and formed opinions about cosmogeny and natural phenomena that ran counter to the book of Genesis Copernicus died before the Inquisition could call him to account for publishing the "De Revolutionibus," while for upholding the views it expressed Giordano Bruno went gallantly to the stake and Galileo's abjuration alone saved him from a like fate

The restriction of humanistic culture to those classics possessing literary and historical worth can be envied since their message from generation to generation is not subject to change The classics of science, on the other hand, while just as ancient, deal with concepts that continue to be in a constant state of flux This is particularly true of the physical sciences for despite their supposedly precise laws, expressible in complicated symbols, it takes a mathematical genius to keep up with the shifting approaches of astronomers and physicists toward a solution of the great riddles of space, time and the atom Meanwhile space gets ever larger and particles ever smaller

Those of us who have clung to the belief that

[5] William A Heidel, Carnegie Institution Publication No 442, Washington, 1933

nature abhors a vacuum and that Archimedes knew what he was about in regard to π being 3 1416 are told that all such old fashioned ideas which failed to take time and the quantum theory into consideration are completely outmoded But who were Pythagoras and Euclid and Aristarchos and Archimedes and Apollonius and Hipparchos, to mention only a few of those who left their names stamped on mathematical science long before the heyday of Rome? In my youth Euclid was the name of a street in Cleveland, Ohio, and then I had of course heard it rumored that Archimedes once got a new idea in his bath—which explained why plumbing was so often hopefully labelled Eureka

Partly as a sop to my humanistic yearnings and partly in the vain hope of stimulating my unmathematical mind, I once purchased a copy of Radolt's famous edition of Euclid's "Elementa" in a monastic binding Possessing that, I could not resist another scientific landmark, the Principia" of Newton, when a copy happened to come within reach Here then on my shelves, if not in my head, were scientific treatises as an evidence of my respect for a branch of knowledge whose theorems and mathematically expressed formulae would supposedly endure for all time

This anticipation, however, was soon shattered by Einstein whose original paper on relativity I was impelled to secure, and though none of it could be understood, a mathematical colleague assured me that it unquestionably represented the last word But no such thing! The chief justice of the High Court of Allahabad has just succeeded, it is said, in reducing the equations of both Einstein and Newton to such simple forms it can be demonstrated that time slows down with distance In other words, it can now be mathematically shown that if A and B are twin brothers and B makes a journey, B must be younger on his return than A Doctors of course have long been aware of the practical truth of this and it explains their custom, when put to it to tell what is wrong with a patient, to suggest travel and change of scene as favorable to longevity

Thus while modern physical science makes headlines for itself so fast there is difficulty even for experts to keep up with it, Sir James Jeans publicly acknowledges that photons, electrons and protons, though their properties can be expressed mathematically, are really as meaningless as x, y and z to a child on its first lesson in algebra, and it has been admitted by someone else that the advance of physical knowledge is at present reduced to the extraction of one incomprehensible from another incomprehensible Yet we are assured that the mathematical starting point for all this was Hero's synthesis of the two laws of Euclid which have merely been expanded by Newton, Einstein and Sulaiman to embrace all the activities of the universe

Though beyond the comprehension of most Renaissance humanists, the impact of the ancient treatises dealing with mathematical subjects certainly had a no less marked effect on the progress of human thought than had the classics of history, philosophy and literature, and it would seem therefore that some familiarity with their purport at least should be as much a part of the fiber of a classical education as the writings of Homer, Virgil, Horace and Cicero

Historians, generally speaking, either from want of understanding or lack of interest have rarely laid stress on the manifold ways in which science and its applications have modified world events and affected human society But since these effects are becoming rapidly accumulative, their consideration by historians will be more and more inevitable as time passes The last great war was precipitated apparently by political rivalries but in its conduct it was clearly a war between the mobilized scientists of the contending parties, for they alone were in a position rapidly to increase the effectiveness of its destructive agencies and in an emergency to devise means of defence against such novel forms of destruction as might be introduced by their opponents It was a sorry business to throw in the lap of Science, though stimulated by the responsibility Science doubtless has profited by it in many ways

But as political historians know better than most others, the almost invariable aftermath of war is a temporary wave of apparent prosperity followed by a more or less prolonged period of economic depression with its social disorders, prevalence of crime, licentiousness and unemployment On these now urgent and world wide problems Science does not as yet appear to have put its mind—or if it has, it has not offered any solution to the problem Society in the interval restlessly endures the situation as best it can, and it is left to time and politicians to find a way out

Meanwhile, a very curious and unexpected thing has happened Science to the average man has become suspect and he has begun to feel that scientific research and the labor saving inventions which grow out of it are chiefly responsible for the hard times and unemployment and uneven distribution of property Legislative bodies have been inclined to ask what after all science is up to, and to question whether the motives that activate it are as altruistic as the scientists in their arrogance would have us believe, they set about to curtail the funds that hitherto have been allotted to governmental research and grow inquisitive regarding the scientific attitude toward such things as the secrets underlying the manufacture of munitions

This is surely a phenomenon of extraordinary interest. Not since the days when they were under close surveillance of the Church have scientists been put in a defensive position of this kind. But in this instance it is not the theologian but the man in the street and on the farm who is asking his neighbor "what price science?" And since the physical scientists in particular take themselves seriously and are prone to regard the results of their activities as benefactions to mankind, they have been struck all of a heap and a number of them have felt obliged to make a public apologia that has been none too convincing.

This surprising situation has been the more remarkable in view of the fact that scientific discoveries have never before been so widely heralded by an organized press agency nor their applications so extensively advertised by exhibitions of scientific progress, like that recently held at Chicago, and by celebrations such as was staged three years ago on the centenary of the discovery of electro-magnetic induction.

Yet could modest Michael Faraday have stepped out of the Royal Institution where in the Christmas holidays of 1860 he had given to a juvenile audience six lectures on the chemical history of a candle, and have seen his familiar London in the dead of night ablaze with indirect lighting, he would, I imagine, have been somewhat taken aback by the responsibility laid at his door for all that the spectacle implied.

A good many people have been left confused, in the present discussion of the matter, as to the distinction between scientist and inventor—between what is called pure science—the disinterested search for truth—and the practical applications of scientific discovery through engineering. This is the more so because the apologists for science, in bolstering up their defence, have chiefly instanced some of the more outstanding scientific inventions and their relation to human comforts and conveniences. Even so, there may be reason to doubt whether the harvester, the internal combustion engine, the electric dynamo, the victrola, the cinema, the radio, the sawed-off machine gun and so on have in the long run been more beneficial or harmful. They enable us to do more in shorter time, to go faster between points, to banish darkness and so on, but how much human society has been benefited by more wheat with less labor, by getting somewhere a little quicker, by the products of Hollywood, the electric light and night life, the radio and its misleading advertisements, the machine gun and banditry, is open to question.

And whether any one thinks more clearly and deeply than before about the social problems that face humankind and whether people as a whole are as contented and happy as they were in simpler times may well be doubted. Invention of course is an inevitable part of science, in so far as the scientist continually has to improvise things to help with his researches, but the trouble comes when business takes both science and engineering into partnership and then through mass production abetted by the psychology of modern supersalesmanship makes the distribution of the economic benefits disturbingly lopsided.

Faraday's discovery was unquestionably the starting point of the electrical industry that has spread over the world and employs a vast number of people. At the same time, with the great expansion of electrical devices, the machine becomes man's chief competitor—the tractor-drawn harvester and gang plow displace hordes of farm hands, road making and track laying and concrete mixing and electric welding machines displace hordes of city laborers, the electric furnace and out goes the chore man, the frigidaire and away with the iceman, the dialling telephone dismisses an army of operators from the switchboard. Countless other illustrations might be given to show how the applications of a scientific discovery may well throw people out of jobs faster than the manufacture of its patented gadgets gives others employment.

A short time ago a distinguished British engineer in extolling what Einstein has called "the limitless perspective and beauty of modern science" referred to the newly completed Battersea Power Station as representing the highest stage of development of the science of engineering, for there three steam turbines with a total output of 300,000 horse-power—a power exceeding that of four and a half million laborers!—could be seen in the engine room all under the control of one man wearing a spotless white coat. While this may appear beautiful to the engineer, there is at the same time something inhuman and terrifying about it.

It is quite true that many patented inventions are purchased and closeted to protect industries that are temporarily stabilized. It is true also that one can not easily foresee what will be the ultimate effect on society of a given invention—like the invention of printing, for example, which in making a new trade threw a vast number of scribes and rubricators out of work. There was no possibility of heading off the reduplication of books even had it been desirable, any more than could the electric light, the telephone, the automobile, the cinema, the radio, the aeroplane and countless other inventions based on scientific experiment and discovery have been pushed aside.

None of them could we now do without. They indubitably have added vastly to the interest and zest of life and at the same time have played a large part in what we have mistakenly idolized as prosperity. It has been estimated, for example, in pointing out the beneficent rôle of applied science that the commercial value of the inventions of one man alone—the late Thomas Edison—have amounted to fifteen thousand million dollars. And just here it seems to

me that in some concealed way lies the crux of the matter. For compared with this vast sum, had Jenner's or Lister's or Pasteur's or Laveran's discoveries been patented and commercialized instead of being outright gifts to humankind, the economic value of any one of them would have been simply incalculable.

Theology, long the controlling factor in our educational system, finally was supplanted and the chief emphasis came to be laid on linguistic and literary culture. This state of things endured until the past century when the great advancement in the natural sciences and engineering enabled their representatives successfully to challenge the supremacy of the classics, thereby securing ultimate parity in the curriculum. At the present time we may be approaching another such change since in some institutions business has come to be accorded the dignity of a university subject. This would not be particularly disturbing were it not for the close association of business with engineering and other applied sciences through the commercialization of their inventions, this contact with its implication of advertising and salesmanship being as remote from the old humanism and its standards of culture as anything well could be.

The view has been expressed by Dr. Sarton that "Science must become more humanistic and that humanism must include science." But this is far from humanism ever coming to include business or from expecting business ever to become humanistic with its ancient maxim that "what's good for business must therefore be good for everybody," which is a little like saying that charity begins at home—and usually ends there. Dr. Sarton, I take it, was using the words in their more truly Ciceronian sense, as David Eugene Smith presumably does in saying[6] that by studying the mathematics of the Greeks in the original texts Regiomontanus was "the first who made humanism the handmaid of science."

So it may be horrifying to scholars to have what appears to be a modern connotation given to this historic word. Regiomontanus, however, was called from Nürnberg to Rome by Pope Sixtus IV to put his mathematical mind on the reform of the calendar and subsequently at his own expense printed the first almanac, a copy of which Columbus supposedly used on his voyages. This to my conception was no less humanistic on his part than taking up the study of Greek the better to understand the principles laid down by the early writers on mathematical and astronomical subjects.

It would be Utopian to expect of commercialized science that it should forego the financial returns from its discoveries and inventions on the grounds that if its activities are so definitely gifts to mankind, mankind should have a larger share in the profits. Yet this has been part and parcel of the ethical code of the doctor and of medical scientists from time immemorial—only to be broken occasionally of late years, I grieve to admit, under the provocation of economic necessity.

Time was when the doctor would have lost caste if he commercialized a secret remedy, the method of preparing a useful drug, a piece of apparatus or a surgical instrument. Now that the barrier has been broken and a university here and there has come to engage in the marketing of such products, there is danger that the tendency may spread and that the profession's long-accepted standards of humanism may come to be lowered. In the past, vast fortunes have been made for quacks and charlatans by the sale through advertising of worthless patent medicines, and the temptation must be great in these hard times for those who have discovered, let us say, some potent tissue extract that proves to be of a high medicinal value. Should it become a universal custom, however, and Medicine thereby become commercialized, she may well hang her head for her lost altruism, particularly should Science come to take a leaf from her book and decide that the greater part of the royalties on her patent rights justly belongs to the people. This has been done in a few instances but the practice is not likely to become universal for human nature is the last thing to change and this is still a practical, that is selfish, world and not the New Atlantis.

It is of course extremely doubtful whether Science is in any way to blame for the economic troubles in which the world has been wallowing. One might with equal reason lay unemployment and the increasing need of insurance against old age at the door of Medicine for keeping more people alive than can be employed. Nevertheless the fact that the question of responsibility has at this time been raised will certainly some day be looked back upon as a matter of great historical interest.

People in general are unquestionably becoming more socially minded—that is, more "humanistic" in its broader sense—and this is everywhere reflected in the governments that undertake, however feebly, to represent them. In a brilliant and courageous address[7] just a year ago before the American Association for the Advancement of Science, that modern Cato, the present Secretary of Agriculture, challenged the assembled scientists and engineers to tell where they were heading; and lest Spengler prove to be right in his pessimistic prophecies, he appealed to them to bend their talents to higher human aims than the mere increase of productive power.

In similar vein the Bishop of Carlisle opened the recent meeting of the British Association at Aberdeen

[6] "History of Mathematics," Vol. I, p. 260, 1923.

[7] Henry A. Wallace, SCIENCE, January 5, 1934.

with a sermon in which he asked whether the time had not come for science to abandon something of its severe spirit of isolation. The entire program of the meeting, indeed, was given over to a consideration of the social consequences of scientific discoveries. It represented a plea for the closer affiliation of science in the task of government "in terms which admit of unfettered inquiry, of undiminished loyalty to the truth, and a vision characteristic of the great age of Greece." This at least is what reports of the meeting said of it, and if that is not an appeal for a more humanistic science one is at a loss what to call it.

Among those who call themselves pure scientists, whatever their particular field, there are many who feel that they would demean themselves and lose caste among their fellows should they engage in researches that obviously point toward some utilitarian purpose. This I have always regarded as an academic pose; for in the disinterested pursuit of knowledge, to stumble, as did Röntgen or the Curies or Banting, on something not only of great scientific importance but which at the same time was immediately applicable to human welfare is certainly nothing to be ashamed of.

There have been plenty of socially minded and benevolent—dare I say humanistic?—scientists in the past. One quickly thinks of Benjamin Franklin, of Count Rumford and Humphry Davy, to give a few examples. Two of them were American-born, and to one of these the citizens of Munich erected a monument in gratitude for the reforms in public service and social economy that he had brought about while a resident in Bavaria. In their day was organized in England a Society for Improving the Condition and Adding to the Comforts of the Poor "by the systematic employment of scientific methods and knowledge."

Whether the present British Science Guild whose professed purpose is "to promote the application of the scientific methods to social problems and public affairs" is an outgrowth or a continuance of the older society I am not prepared to say, but the fact that no such organization exists in America should give our scientists pause. Never was there greater need for such a movement, and people are beginning to ask why our social problems are not being attacked by those presumably best fitted to solve them because of their familiarity with scientific methods.

Something of the sort might well enough grow out of the Science Advisory Board recently appointed to give advice and make recommendations to the government regarding ways in which science might be of service to the public interest. And should the leaders among our scientists grow more sensitive to the mood of the times and be persuaded at this juncture to focus their highly trained and inventive minds intensively on these difficult subjects, a more humanistic attitude of science or humanization of scientific effort might result which might check the present trend toward a machine-made and -operated civilization whose social dislocations more than offset the personal convenience of its many time-saving and labor-saving devices.

So let us hope that when some future student of this confused and disconcerting period in our history comes to tell of it, he will be able to say: That at the very time when such progress in their subjects was being made as never before, with one discovery following on the heels of another, the scientists and engineers of the country temporarily abandoned the investigations dear to their hearts in order to concentrate on problems the most difficult of all to solve—those that have to do with the social well-being of the community at large. Thus, under a quickly spreading Religion of Humanity, there began a new era—one in which scientists took a commanding position in a rapidly changing world and through their well-planned and executed experiments a new and rational science of society came into being and made its first great forward movement.

It has been said[8] that one distinct advantage we hold over our predecessors is that we have more history behind us; and that the value of classical studies is what they teach us, by example or warning, of the experiences of the civilizations from which we have sprung. So in all likelihood my imaginary historian in recording the new humanistic spirit that was born of the great depression will have occasion to add that those who played the most effective part in bringing it about, whether scientists or not, were persons who knew where were to be found the most noble examples of civic duty, who were familiar with the long history of another republic and who remembered Cicero's maxim, *Salus populi suprema lex esto.*

OBITUARY

DEATH OF THREE FORMER PRESIDENTS OF THE PHYSICS CLUB OF PHILADELPHIA

DURING recent months the Physics Club of Philadelphia has lost by death three of its former presidents.

Edward A. Partridge, president during 1912–13, died on March 22, 1934. He was educated at Central High School, Philadelphia, and at the University of Pennsylvania. In 1898 he was awarded the doctor's degree in mathematics. His life work was science

[8] J. W. Mackail's "Classical Studies," 1925, XII.

teaching in the Philadelphia schools He was in charge of the department of science at West Philadelphia High School from 1912 to the day of his death

He represents a vanishing type—the true scholar engaged in public secondary education He collected a library of several thousand volumes on physics, philosophy, mathematics, astronomy and general literature He read the important languages of Western Europe He held memberships in many learned societies and was a constant reader of scientific journals He was one of the first scholars in Philadelphia to sense the importance of the famous Einstein paper of 1916 and to discuss it in public

In his pupils he assumed the existence of intelligence and intellectual curiosity To these qualities he appealed A record of more than forty years of inspiring teaching bears testimony to the genuineness of his educational philosophy

Joseph M Jameson, president during 1921–22, died on August 4, 1934 He was a native Pennsylvanian and was educated at Cornell University He was in charge of physics at Pratt Institute for fifteen years, and from 1913 to his death was vice president of Girard College He was the author of "Elementary Practical Mechanics' and edited the Wiley Technical Series He was active in scientific and educational societies He wrote numerous articles on problems of science teaching In recognition of his services to education Temple University awarded him the honorary degree of doctor of pedagogy in 1920

In his teaching of physics, Dr Jameson assumed in his pupils an interest in the machines, inventions and appliances of everyday life He sought to convert this interest into a desire to comprehend the underlying sciences This was his favorite method It has numerous adherents in the educational world, and among them Dr Jameson was recognized as one of its ablest spokesmen

Edward J Brady, president during 1925–26, lost his life at sea on the morning of September 8, 1934, in consequence of the burning of the steamship *Morro Castle* He was educated at Cornell University For many years he had been in charge of the Physical Laboratory of the United Gas Improvement Company

He was the inventor of the Brady B T U Indicator, a device used in gas plants throughout the world For this invention he was awarded the Beal gold medal in 1919 He developed laboratory methods used in testing gas, oils and high temperature refractories

The laboratory which he directed bears the stamp of his genial and wholesome personality A member of his staff has said, "A year under his patient and able training was the equivalent of a graduate course in pure and applied physics" He was a member of many scientific and engineering societies Among them the Physics Club ranked as a favorite hobby

All three were men of sterling character and attractive personal traits, respected and admired by their associates Through the death of these men this club has lost some of its most active members, and Philadelphia has lost three of its ablest men of science and three exemplary citizens

DR BERTRAM H BUXTON

1852–1934

A UNIQUE figure passed from the ranks of British and American scientific investigators by the death of Dr Bertram H Buxton, which occurred at Devon, England, on December 5, 1934, at the age of 82 years His life covered two full generations and witnessed the development of most of our modern science

His work began in the early nineties, on board a cholera ship in New York Harbor, under Commissioner Doty In 1902 he became pathologist to the Memorial Hospital, where he prepared Coley's toxins for the treatment of inoperable sarcoma He then became director of the Huntington Fund for Cancer Research In Cornell University Medical College he worked many years in the Loomis Laboratory, in bacteriology, biology and pathology He was appointed instructor in bacteriology in 1898, associate professor of biology in 1903 and professor of experimental pathology in 1904 He returned to England in 1912 He made important contributions on the differential diagnosis of paratyphoid fever, on the bacteriology of typhoid fever, and on the physical chemistry of agglutination He distrusted researches directed toward immediate practical ends When a series of papers on 'Absorption from the Peritoneal Cavity" seemed likely to have practical or commercial importance, he abandoned the field at once, went to Venezuela and produced a remarkable study of the invertebrate eye He was a pioneer and expert in microphotography, and some of his early work has never been surpassed His sole diversion was riding the bicycle and his remarkable skill in trick performances was long remembered by the pedestrians on the upper west side of Central Park

Writing in the London *Times*, Dr C G L Wolf says "His beautiful and original researches in the physical chemistry of agglutination laid a foundation of much of the very practical work now being done on the assay of toxins and antitoxins The perfect charm, breadth of view, and superb technique are memories of Buxton which will not easily be forgotten by his many pupils and associates"

On returning to England he engaged in the study of plant physiology, especially the pigment functions and the production of hybrids At the John Innes

Horticultural Institution he produced by mutation a giant fertile hybrid of foxglove which was recognized by the Kew authorities as a new species

He was a pure scientific investigator, an artist in all things, and whatever he undertook he carried through outstandingly well He was so modest and unassuming that his fine qualities were appreciated only by those closely associated with him

JAMES EWING

RECENT DEATHS

DR. HERDMAN F CLELAND, professor of geology at Williams College, was drowned when the steamship *Mohawk* sank on January 24 He was sixty five years old

DR. ALBERT MANN, since 1919 research associate in botany at the Carnegie Institution of Washington, died on February 1 at the age of eighty-one years

DR GRANVILLE MACGOWAN formerly professor of surgery at the University of California, died on January 31 at the age of seventy seven years He was president of the American Urological Association in 1912

FREDERICK S DELLENBAUGH, anthropologist and explorer, died on January 29 at the age of eighty one years

MISS ROSALIE B J LULHAM, lecturer in natural history at the Froebel Educational Institute and author of 'An Introduction to Zoology through Nature Study," died on December 28

SCIENTIFIC EVENTS

THE PUBLIC HEALTH OF INDIA

THE report for 1931 of Major-General J D Graham, Public Health Commissioner with the Government of India, has recently been made public According to the *British Medical Journal*, General Graham insists on India's need of an organization which shall be capable of framing and conducting a public health policy for the country as a whole Such a Ministry of Health is found in Canada, Australia and South Africa, and is none the less necessary in India because the executive control of public health has been transferred to the Provinces

A census was taken in February, 1931, and vital statistics for the year can be more accurately estimated than in the nine previous years, the last census having been taken in 1921 The birth rate for the year in British India was 34 3 per mille, as compared with 33 4 on the estimated population for 1930, and 35 7 for the previous quinquennium (based on the 1921 census) The general death rate was 24 8 per mille, and the death rate for infants under the age of 12 months per 1,000 live births was 178 8, as compared with 180 8 in 1930 and 177 6 in the previous quinquennium Out of every 190 deaths recorded, forty three occurred in children below the age of 5, and forty eight in those below the age of 10 The infantile death rate for British India was nearly 2⅗ times that for England and Wales and South Africa, more than double that for Germany, and nearly 5½ times that for New Zealand Countries in which the figures compare more closely with those of British India include Rumania, Hungary, Japan, Italy, Egypt and Soviet Russia The three main causes of infantile mortality are given as congenital and developmental defects, alimentary disturbances and infective disease, the first accounting for nearly all stillbirths and deaths in the first seven days of life, while the two latter affect the older children Sanitary improvements have operated against the two latter causes, but not against the first, and in the production of these defects prematurity plays an important part

Antimalarial campaigns continued during the year under review, including cinchonization schemes where funds permitted Tuberculosis is believed to be generally on the increase, especially in some of the larger and more overcrowded cities, such as Peshawar, Delhi and Calcutta The anti tuberculosis campaign has not proceeded very far as yet, but the disease is now notifiable in the Punjab, the Central Provinces, Madras, Baluchistan and in municipal areas in Assam and the Upper Provinces In Bombay Presidency, out of every 1,000 deaths recorded in 1931, 43 6 were ascribed to pulmonary tuberculosis In 1931 there was a large fall in the incidence of cholera in British India, apart from the Presidency of Bombay, but high mortality curves were present in Bengal and Bombay The death rate for plague was, however, twice that in 1930, although lower than that in 1929, the Upper Provinces suffering most

Leprosy surveys, which had been continued during three and a half years, were ended in 1931 They showed that leprosy was much more prevalent in India than was formerly supposed, probably one million cases would not be an overestimate The disease was found to be most common among semi aboriginals or aboriginals, who left their tribal seclusion and hired themselves out to agriculturists or industrial concerns. Infection of the more advanced classes of the community was in the first place largely attributable to the employment of servants in an infectious stage Movements of the population, which have increased

on account of better education and transport in recent years, are a potent factor in spreading the disease and in infecting new areas. This is General Graham's last annual report as Public Health Commissioner and he briefly reviews his decennium in that office and indicates the more salient advances.

THE FIELD MUSEUM ANTHROPOLOGICAL EXPEDITION TO THE NEAR EAST

THE Field Museum Anthropological Expedition to the Near East, sponsored by Marshall Field, has concluded its work for 1934, consisting of an anthropometric survey of the native population of Iraq, and similar studies in Persia and the Caucasus region of the U.S.S.R.

The leader of the expedition, Henry Field, assistant curator of physical anthropology, has returned to his post in the museum, ready to begin the task of assembling and studying the data collected, which has for its purpose an attempt to solve certain racial problems. One of the objectives is to determine the relationship of the peoples of the Near East, both those of to-day and their ancient ancestors, to the modern and ancient peoples of Africa, Europe and Asia. This is a question of great scientific importance into which no satisfactory research has previously been made.

The work of the expedition covered a period of ten months, during which 17,000 miles were traveled, and 3,000 persons were submitted to studies, consisting of anthropometric measurements and observations, the taking of front and profile photographs, hair samples, blood samples, and other data pertinent to tracing racial origins. In addition to its anthropological work, the expedition collected 3,000 animals, 1,000 insects, 2,600 plants and a quantity of geological material, for the departments of zoology, botany and geology.

Mr. Field was accompanied by Richard A. Martin, of Chicago, who as photographer made 7,000 negatives, and in addition collected the zoological material, as well as assisting the leader in the anthropological work. As many as twelve assistants were attached to the expedition temporarily at various points for local work. The anthropological studies were a continuation of the survey begun by Mr. Field in 1925.

Observations were made upon selected subjects from each of the important racial groups. Of special interest in Iraq were the Kurds, fierce-looking mountain tribesmen, of whom 750 submitted to the anthropologists' calipers and cameras, and the Yezidis, fanatical devil-worshipers, 300 of whom cooperated by acting as scientific specimens. Forty separate measurements and observations were made on each individual. Living in tents as guests of Sheikh Agil, great desert chieftain of the Shammar Beduins, the members of the expedition were enabled to measure 450 members of this tribe.

The expedition made an archeological survey of the North Arabian Desert, crossing from Baghdad to Trans-Jordan Palestine and Syria, and thence returning to Iraq. During this trip a large number of prehistoric flint implements testifying to the existence of early man in this area were collected.

After five months in these areas, the expedition proceeded to Persia, where anthropological studies were made of some 250 individuals. After completing its work in that country, the expedition entered the U.S.S.R. at Baku, and traveled through the Caucasus to Kiev, Moscow and Leningrad. In the mountains of the Caucasus some 200 men and women were studied.

PENNSYLVANIA'S PRIMEVAL FOREST

EDWARD E. WILDMAN, member of the "Tionesta Committee" of the Pennsylvania Forestry Association, writes that on Friday, November 23, 1934, the National Forest Conservation Commission approved the purchase by the United States Forest Service of 4,000 acres of primeval forest still standing in Warren and McKean Counties, Pennsylvania, in the northwest section of the state, and within the limits of the Allegheny National Forest Reservation. It is known as the Tionesta Tract.

The stand is mainly a hemlock-mixed hardwood type, with fine old trees here and there of black cherry and cucumber. The Pennsylvania Forestry Association has been urging the preservation of this tract for the past three years as a forest laboratory where only observation, not experimentation, should be carried on. It is with this understanding that the commission authorized its purchase. Trails will be made into the forest where they can be laid without cutting, but no camping there is contemplated.

Under the title "The Thousandth Acre," the tract was described by the Allegheny Forest Research director, R. D. Forbes, recently in *American Forests*.

The Forest Service wants to see how this forest maintains itself and its wild life century after century totally undisturbed by man. Its fauna and flora are typical of the Middle Atlantic States, and therefore this tract is unique, for those of the nearest primeval regions now preserved—the Adirondacks on the north and the Great Smokies on the south—are different in many features. Mr. Wildman writes:

> Not only professional foresters, but every student of natural history and every lover of the untouched wilderness will be glad to hear of the success of the association in this endeavor.

Historically, its preservation is most fitting, for this tract is part of the actual forest that gave the name Pennsylvania to the province when it was granted to William Penn in 1681. Indeed, the association began its work for the preservation of this tract as its part of the program of celebration in 1932 of the 250th anniversary of the coming of William Penn to his province. Philadelphia and other cities along the Delaware celebrated that event in various beautiful and appropriate ways, but for lovers of the out-of-doors, and Penn himself was one, the preservation of this large tract of Penn's own woods will be counted perhaps first in such a memorial program.

GRANTS OF THE ELLA SACHS PLOTZ FOUNDATION

DURING the eleventh year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-three applications for grants were received by the trustees, forty of which came from the United States, the other forty-three from thirteen different countries in Europe, Asia and Africa. The total number of grants made during 1934 was twenty-seven, one of these being a continued annual grant. Fourteen of the new grants were made to those working in science outside of the United States.

In the eleven years of its existence, the foundation has made two hundred and twenty-seven grants, and investigators have been aided in Argentina, Austria, Belgium, Chile, China, Czechoslovakia, Esthonia, France, Germany, Great Britain, Hungary, Italy, Jugoslavia, Latvia, Netherlands, Palestine, Poland, Portugal, Roumania, South Africa, Sweden, Switzerland, Syria and the United States.

The list of investigators and the purpose of their researches aided during 1934 is as follows:

Dr. Z. M. Bacq and Dr. M. Florkin, Liége, Belgium, study of the action of various drugs, in relation to the autonomic nervous system, and to the potassium content of the blood serum; Dr. S. J. Crowe, Johns Hopkins Hospital, continuation of experiments on the physiology of the ear; Professor Ludwig Braun, Vienna, Austria, continuation of studies of heart disease; Dr. Douglas R. Drury, University of Southern California Medical School, investigation of experimental renal insufficiency; Dr. Hans Dworzak and Dr. Kurt Podleschka, Prague, Czechoslovakia, study of the growth of ovaries transplanted into the eyes of rabbits as influenced by different hormones; Professor Dr. Philipp Ellinger, London, England, continuation of work on the physiology, pathology and pharmacology of the kidney, and research on microscopical observations of the beginnings of cancer by method of intravital staining; Dr. Giovanni Favilli, Florence, Italy, work on Brucella polysaccharides; Professor René Gayet, Paris, continuation of researches on the output of blood from various organs; Dr. Arthur Grollman, Johns Hopkins University Medical School, continuation of chemical studies on the nature of the adrenal cortical hormone and an investigation of its physiological interrelationships in the organism; Dr. Ellis H. Hudson, Deir-ez-Zor, Syria, investigation of the Arab type of childhood syphilis; Dr. H. D. Kay, Berks, England, investigation concerning the relationship of phosphorus deficiency to rickets; Dr. Edgar Lederer, Paris, continuation of work on carotinoids and vitamins; Dr. David Marine, Montefiore Hospital, further study of experimental exophthalmos and thyroid hyperplasia together with the effect of the antigoitrous agent (ascorbic acid) on these conditions; Dr. Ernst Mueller, Presbyterian Hospital, New York City, capillary pressure estimations; Dr. John P. Peters, Yale University School of Medicine, certain studies of water and salt metabolism, with special reference to nephritis; Dr. Hermann Pinkus, University of Michigan Medical School, investigations with cultures of human tissues, particularly in connection with cancer work; Dr. Eugene Pollak, Vienna, Austria, study of lipoid catabolism in the central nervous system; Professor Hans Pringsheim, Paris, researches in the chemistry and biochemistry of polysaccharides; Dr. Samuel H. Proger, Boston Dispensary, continuation of work on the effect on patients with heart disease of lowering the level of energy metabolism by means of prolonged dietary restriction; Dr. Jane Sands Robb, Syracuse University Medical School, study of the conduction paths in the mammalian ventricles; Professor Rothberger, Vienna, Austria, electrocardiographic research; Thorndike Memorial Laboratory, Boston City Hospital (Professor George R. Minot, director), continued since 1927 in recognition of Dr. Francis W. Peabody's services to the foundation; Professor Waldschmidt-Leitz, Prague, Czechoslovakia, study of the ferments in cancer; Dr. Carl J. Wiggers, Western Reserve University, continuation of work on the dynamics of the coronary circulation; Dr. William F. Windle, Northwestern University, study of the development of behavior in the embryo correlated with the development of intrinsic structure in the nervous system; Dr. M. M. Wintrobe, Johns Hopkins Hospital, studies of the morphological changes in red blood corpuscles in animals; Professor René Wurmser, Paris, continuation of studies of oxidation reduction phenomena in cells.

The maximum size of grants will usually be less than $500. Applications for grants to be held during the year 1935–1936 must be in the hands of the executive committee before May 1. There are no formal application blanks, but letters asking for aid must state definitely the qualifications of the investigator, the character of the proposed research, the size of grant requested and the specific use of the money to be expended. Only applications complying with the above conditions will be considered. It is also highly desirable to include letters of recommendation from the directors of laboratories or clinics in which the work is to be done.

THE ANNUAL MEETING OF THE SMITHSONIAN INSTITUTION

NOTABLE scientific advances in the face of seriously curtailed income were reported to the Board of Re-

gents of the Smithsonian Institution, at their annual meeting on January 17 Dr Charles G Abbot, the secretary, reports that while it has been necessary to curtail seriously research, explorations and publications, the year has been exceptionally fruitful Very significant progress is believed to have been made in the study of the dependence of weather upon variations in the sun's heat and also much accurate data have resulted in the Division of Radiation and Organisms Notable archeological progress was made by CWA projects in charge of members of the institution's staff Otherwise field work was reduced to a minimum, owing to lack of funds

Dr Abbot announced one bequest, amounting to more than $58,000, from William Herbert Rollins, of Boston, to establish a fund "for exploration beyond the boundary of knowledge" New specimens to the number of 340,780 were added to the collections of the National Museum These included valuable anthropological materials from Africa, Honduras, Nicaragua, Australia, Alaska and various regions of the United States, large collections of mammals, birds and other forms of life from China and Siam, unusually large collections of insects, one alone numbering 69,000 specimens, and many important plant specimens from North and South America, Hawaii, Poland and French Indo China

Among the large number of rocks, gems, meteorites and fossils obtained, special mention was given by Dr Abbot to the collection of 25,000 rocks assembled by the late Dr Henry S Washington, one of the world's leading petrologists, and to the Tellef Dahll collection of minerals from Norway An important addition to the Arts and Industries collection was the airplane in which Galbraith P Rodgers completed the first flight across the United States in 1911 To the historical collections Mrs Herbert Hoover added a costume worn by her at the White House

The collections of the Freer Gallery of Art were increased during the year by specimens of Arabic bookbinding, Chinese bronzes, Chinese and Persian ceramics, Arabic glass, Chinese gold work, an Armenian manuscript, and Chinese, Byzantine, Indian and Persian paintings The need was stressed for more adequate buildings for the National Zoological Park, with more than 2,000 valuable animals

Work has continued during the year, he reported, on intensive study of the biological specimens obtained by the Johnson Smithsonian Deep Sea Expedition to the Puerto Rican Deep last year, and fifteen papers describing new forms have been published The year marked the conclusion of the research of Dr C U Clark in European archives for material concerning the early history and exploration of America Some very valuable manuscripts were brought to light, which would be published if funds were available

Chief Justice Charles Evans Hughes, chancellor of the Smithsonian Institution, presided at the annual meeting of the regents The board is composed of the following members Vice president Garner, Senators Joseph T Robinson and M M Logan, Representatives T Alan Goldsborough and Charles L Gifford, and Irwin B Laughlin, Frederic A Delano, John C Merriam, R Walton Moore, Robert W Bingham and Augustus P Loring

SCIENTIFIC NOTES AND NEWS

THE council of the British Institution of Electrical Engineers have awarded the Faraday Medal to Dr Frank B Jewett, president of the Bell Telephone Laboratories and vice-president of the American Telephone and Telegraph Company

THE two gold medals of the American Institute, established more than a century ago, have been awarded this year to the Rev Julius A Nieuwland, Notre Dame University, and to Dr Carl D Anderson, the California Institute of Technology, it has been announced Presentation of the medals took place at the annual dinner of the American Institute at the Hotel Astor on February 7 The award to Father Nieuwland is for his discovery of a process for making synthetic rubber Dr Anderson is honored for his discovery of the positron, of the positive electron, a new fundamental unit of matter, having the mass as the electron but carrying a positive unit of electric charge

THE 1935 gold medal of the Royal Astronomical Society of London has been awarded to Professor E A Milne, Rouse Ball professor of mathematics at Oxford University, 'for his work on radiative equilibrium and theory of stellar atmospheres" The gold medals for the previous two years were awarded to Professor V M Slipher, of the Lowell Observatory, in 1933, and Dr Harlow Shapley, of the Harvard College Observatory, in 1934

PROFESSOR HAROLD C UREY, discoverer of heavy water and winner of the Nobel Prize in chemistry for 1934, was honored at a farewell dinner on the night of February 1 by the Chemists' Club in New York City Professor Urey, accompanied by Mrs Urey, sailed on February 2 on the *S S Gripsholm* for Sweden, where he will deliver the Nobel address before the Swedish Royal Academy of Science on February 14. About 125 metropolitan chemists, including the board of trustees of the Chemists' Club, attended the dinner Professor Victor K. LaMer, of Columbia University, de-

livered the principal address, reviewing Professor Urey's work with the heavy isotope of hydrogen Dr George Murphy, of Columbia University, and Dr F G Brickwedde, of the Cryogenic Laboratory of the U S Bureau of Standards, who assisted Professor Urey in his experimental work, were guests of honor and spoke briefly Professor Marston T Bogert, of Columbia University, was the toastmaster

A TESTIMONIAL dinner was given to Dr George Hoyt Whipple, professor of pathology and dean at the University of Rochester School of Medicine, on January 15 in recognition of his work on anemia Dr Whipple was one of the three recipients of the Nobel Prize in physiology and medicine in 1934

DR CLARENCE H KENNEDY, professor of zoology and entomology at the Ohio State University, has been elected president of the Entomological Society of America

OFFICERS of the Pathological Society of Philadelphia have been elected as follows *President,* Dr Morton McCutcheon, *Vice president,* Dr Esmond R Long, *Secretary Treasurer* Dr Herbert L Ratcliffe

SIX members of the faculty at the University of North Carolina have been promoted to the rank of Kenan professors They are Dr Edgar W Knight, professor of education, Dr John F Dashiell, head of the department of psychology, Dr William M Dey, head of the department of romance languages, Dr Gustave A Harrer, professor in the department of Latin, George Coffin Taylor, professor in the department of engineering, and Erich W Zimmerman, professor in the department of economics The appointments are made possible by the Kenan Professorship Endowment, a fund which was bequeathed to the university in 1916 by the will of the late Mary Lilly Kenan Bingham

DR. LINUS WARD KLINE, director of the department of psychology, and Mrs Frances Littleton Kline, associate professor of chemistry, have resigned from the faculty of Skidmore College Dr Carl E Smith, assistant in the department of psychology at Harvard, has been appointed to succeed Dr Kline in September

THE following are changes in the staff of the school of chemistry and physics at the Pennsylvania State College Dr J H Simons, secretary of Section C of the American Association for the Advancement of Science, has been appointed associate professor of physical chemistry Dr F L Carnahan will replace W B McCluer in charge of the Petroleum Refining Laboratory supported by the Pennsylvania Grade Crude Oil Association as part of Dr Fenske's petroleum refining research unit Mr McCluer has joined the technical staff of the Kendall Refining Company

THE Buffalo Museum of Science has appointed Dr A E Alexander as research associate in mineralogy and petrography Dr Alexander was formerly petrographer with the Spencer Lens Company

PROFESSOR MARTIN MEYER, of Brooklyn College, has been appointed acting head of the department of chemistry, in place of Professor Frederick E Breithut, who has been assigned to special work in connection with the construction of the proposed new Brooklyn College buildings

DR EDWIN MATTHEW, honorary physician at the Edinburgh Royal Infirmary and Leith Hospital, has been appointed to the chair of clinical medicine at the University of Edinburgh He succeeds Professor Edwin Bramwell, who resigned on January 1

PROFESSOR JUVENAL VALERIO RODRÍGUEZ has been appointed director of the National Museum of Costa Rica Professor Rodriguez is a botanist who has devoted much time to study of the Costa Rican flora

PROFESSOR AUSTIN M PATTERSON, head of the department of chemistry and vice president of Antioch College, has been appointed to the newly constituted international committee on organic chemical nomenclature of the International Union of Chemistry The other members of the committee are Mario Betti, Bologna, R Marquis, Paris, Friedrich Richter, Berlin, and P E Verkade, Rotterdam

PROFESSOR W R LONGLEY of Yale University, was nominated as representative of the Mathematical Association of America on the National Research Council for a three year term from July 1, 1935, in succession to Professor H L Rietz

DR HERBERT S JENNINGS Henry Walters professor of zoology and director of laboratories at the Johns Hopkins University, spoke on "What is the Rôle of Mutations in Evolution?" at the meeting of the American Philosophical Society on February 1 in Philadelphia

DR. ABRAHAM FLEXNER, director of the Institute for Advanced Study, Princeton University, and Dr Morgan Ward, also of Princeton University, will be guest speakers at The Mathematics Chairmen's Association at its annual open luncheon meeting on February 16, at the Hotel Astor in New York at 10 o'clock

PROFESSOR WM SEIFRIZ, of the University of Pennsylvania, lectured on January 26 before the Botanical Seminar of the Johns Hopkins University on "The Forests of the Western Caucasus and Mt Elbruz"

AT the 103rd annual general meeting of the Harveian Society of London, held on January 10, Dr A Hope Gosse delivered the presidential address on "The Diagnosis of Diseases of the Chest by Means of

X-rays." Dr. Gosse then inducted his successor, L. E. C. Norbury, in the presidential chair. The following officers were elected for the ensuing year: *Vice-presidents,* Dr. G. Macdonald Critchley, Professor Tom Hare, Dr. N. Gray Hill, Professor C. A. Pannett; *Hon. treasurer,* Cecil P. G. Wakeley; *Hon. secretaries,* Dr. A. D. Morris and John Hunter; *Council,* Dr. D. H. Brinton, Dr. F. S. Cooksey, Dr. A. Hope Gosse, Dr. Norman Hill, Dr. F. Hobday, Dr. T. C. Hunt, Dr. A. F. Morcom, Dr. A. D. Munro, W. E. Tanner, Dr. G. de Bec Turtle, Dr. R. R. Watts and A. Dickson-Wright.

DR. ELLIOTT C. CUTLER, Moseley professor of surgery at Harvard University Medical School, will give the second lecture in the annual Judd Lectureship in surgery on the evening of Tuesday, February 19, in the auditorium of the chemistry building at the University of Minnesota. The subject of Dr. Cutler's lecture will be "Total Thyroidectomy for Heart Disease."

A LECTURE series, made possible by the Kellogg Foundation, will be given at Rutgers University beginning on February 27. The first lecture will be given by Dr. William Beebe, curator and director of the department of tropical research of the New York Zoological Society. Subsequent lectures on March 27 and April 17 will be given, respectively, by Donald R. Richberg, executive director of the United States Emergency Council, and Dr. Robert A. Millikan, of the California Institute of Technology.

SIR FREDERICK GOWLAND HOPKINS, president of the Royal Society, delivered the Sir Henry Trueman Wood Memorial Lecture on "The Study of Human Nutrition; the Outlook To-day," at the Royal Society of Arts in London on February 5.

SIR WILLIAM BRAGG, Fullerian professor of chemistry at the Royal Institution and director of the Davy-Faraday research laboratory, lectured before the Royal Institution on January 18 on "The Theoretical Strength and Practical Weakness of Materials."

AN Association of Southern California Botanists was organized at a meeting held on November 3, 1934, at the University of California at Los Angeles, Professor G. J. Peirce, professor of botany at Stanford University, presiding. The group is to include teachers in high schools, junior colleges, colleges and universities, members of experiment stations and research laboratories, state and federal services, and individuals interested in botanical subjects. The activities of the organization will be arranged by a governing board. The board members chosen on November 3 are: Dr. O. L. Sponsler, professor of botany at the University of California at Los Angeles; Dr. Howard de Forest, head of the department of botany at University of Southern California; Dr. E. M. Harvey, plant physiologist, bureau of plant industry, U. S. Department of Agriculture; Dr. James V. Harvey, professor of botany, San Bernardino Junior College; Dr. Robert Emerson, assistant professor of biophysics, California Institute of Technology.

A MEETING of the New England section of the American Physical Society was held at the George Eastman laboratory of the Massachusetts Institute of Technology on February 2.

THE second annual convention of Maryland Teachers of Biology will be held on April 13, at the Maryland Academy of Sciences building, Baltimore, beginning at 10 o'clock, A. M. There will be a morning, an afternoon and an evening session, with a dinner at 6:15.

A NEW quarterly publication entitled *Farm Research* will be issued by the New York State Agricultural Experiment Station at Geneva. The chief aim of the new publication is to present the results of the research work of the station to the farmers of the state by means of brief popular articles prepared by members of the research staff.

THE Field Museum of Natural History has come into possession of an addition to its library of some 5,000 volumes, including much material of extreme rarity and value, left to it by the late Dr. Berthold Laufer, curator of the department of anthropology, who died in September, 1934. Simultaneously the American Friends of China, Chicago, as a memorial to Dr. Laufer, made a gift of $500 to the museum to be used for expenses in connection with the cataloguing and arrangement of the Laufer Library in a manner that will increase its usefulness.

A GRANT of $1,000 has been made by the National Research Council to the department of chemical engineering of the Massachusetts Institute of Technology for research on gel structures in cement. The work will be under the direction of Dr. L. S. Brown.

INCOME from the $450,000 Bowman bequest will, for the time being, be used by the University of Wisconsin to establish a series of special cancer research fellowships. The board voted also to continue the special committee which it set up several months ago to decide in what ways the income from the fund could be put to the best use in cancer research work. Those on the committee are President Glenn Frank, Dean Charles R. Bardeen, of the medical school, and Dean E. B. Fred, of the graduate school. Establishment of the series of special cancer research fellowships is expected to permit the university to push forward its efforts to determine the causes and cure of cancer. The fellowships will bring to the university those who are specializing in that field of medical research, and

will add impetus to the work which is already being carried on by other institutions. Income from the Bowman fund, which was left to the university in the will of the late Jennie Bowman, Wisconsin Dells, who died early in 1934, will amount to about $12,000 yearly at present, but is expected to become larger in future years.

THE American-Scandinavian Foundation will this year award a special fellowship of $1,000 for research in electrical engineering in Sweden. This fellowship is named for Irving Langmuir, winner of the Nobel Prize in 1932, and the recipient will be expected to visit Dr. Langmuir and his associates at the General Electric Company before leaving for Sweden. We learn from the *Journal of Industrial and Engineering Chemistry* that in April the foundation will award to students of American birth a number of traveling fellowships for study in various fields of science in the Scandinavian countries during the academic year 1935–36. The fellowships will carry stipends of $1,000 each. Graduate students and younger instructors and professors are especially invited to become candidates. Wherever possible the papers of all applicants from one institution should be considered first by a committee of professors in that institution and forwarded to the jury with an indication of preference. Application papers, including letters of recommendation and photograph, must be filed at the office of the foundation before March 15, 1935. The jury which makes the final selection is composed of college professors and technical experts and has as chairman Professor William Hovgaard, of the Massachusetts Institute of Technology.

THE Committee on Scientific Research of the American Medical Association has made a grant to Professor Edward S. West, of the University of Oregon Medical School, for studies on hydroxylated fatty acids.

UNDER the national fellowship plan of the chemistry department of the Johns Hopkins University four fellowships for graduate study in chemistry are open to qualified students in colleges and universities. The four are the American Can Company Fellowship for California, the Mary Carroll Garvan Fellowship for Connecticut, the G. A. Pfeiffer Fellowship for Iowa and the Chemical Foundation Fellowship for the states of Arizona, Idaho, Nevada, New Mexico, South Dakota and Wyoming. The purpose of the National Fellowship Plan is described as "the selection and training of chemists who are especially fitted to contribute to fundamental chemical research." The fellowships are held for a period of four years, contingent upon the satisfactory progress of the student. They give the recipients an opportunity for basic training and original research in chemistry and related subjects. In addition to the essential curriculum, the students are given an opportunity for personal contact with leading European and American chemists, through a visiting lectureship which has been provided by Dr. A. R. L. Dohme, of Baltimore. The selection of the successful candidate is accomplished through state committees which evaluate the student's complete previous scholastic record and his personal qualities as rated by his instructors. Students in the sophomore, junior and senior year of the colleges and universities of the designated state are eligible for the fellowships, or students anywhere in the United States provided they hold their residence in one of the respective states. The successful candidates will be notified on or before April 15, and will begin their work at the Johns Hopkins University in October. Applications should be made to Professor Neil E. Gordon, the Johns Hopkins University, by February 15.

THE fifth annual series of free public health lectures presented jointly by the Cleveland Academy of Medicine and the Albert Fairchild Holden Foundation will begin on January 13 with an address by Dr. Gerald S. Shibley, associate professor of medicine, Western Reserve University School of Medicine, on "The Common Cold." Succeeding lectures will be given by Drs. Russell L. Haden, on "Anemias and Diet"; Marion A. Blankenhorn, "The Art and Science of Diagnosis," and John A. Toomey, "Stopping the Spread of Contagions."

A SERIES of twelve public lectures on medical subjects will be given by members of the teaching staff of Harvard University at the Medical School on successive Sunday afternoons. The series began on January 6 and will end on March 26. The lecturers and their subjects are: Dr. R. G. Hoskins, research associate in physiology, "Gland Factors in Personality"; Dr. H. B. Sprague, assistant in medicine, "What Causes Heart Disease?"; Dr. Alice Hamilton, assistant professor of industrial medicine, "Dangerous Trades"; Dr. J. O. Pinkston, teaching fellow in physiology, "The Body Temperature"; Dr. H. D. Chadwick, lecturer on public health administration, "Tuberculosis as a Children's Disease"; Dr. H. C. Trimble, assistant professor of biological chemistry, "Minerals in our Bodies and our Foods"; Dr. H. F. Root, assistant in medicine, "Diabetes"; Dr. D. B. Dill, assistant professor of biological chemistry, "External Influences on Physical Activity"; Dr. E. C. Cutler, Moseley professor of surgery, "Cancer"; Dr. G. H. Parker, professor of zoology and director of the Zoological Laboratory, "Twins and Social Biology"; Dr. C. B. Vaughan, assistant professor of clinical dentistry, "Facts regarding the Control of Diseases of the Gums"; Dr. F. C. Irving, professor of obstetrics, "Inheritance."

DISCUSSION

A WIDE-SPREAD ERROR RELATING TO EGYPTIAN MATHEMATICS

IN a recent book entitled "Vorlesungen über Geschichte der Antiken Mathematischen Wissenschaften" (Vol 1, p 122, 1934), its author, O Neugebauer, directs attention to a popular mathematical legend which seems to have been started by the late Moritz Cantor (1829–1920) who has some times been called the prince of mathematical historians According to this legend, the ancient Egyptians constructed right angles by means of a cord with three knots separated by distances in the proportion of 3, 4 5 This legend appears, among many other places, in the most commonly used American textbooks on the general history of mathematics as well as in those of various other countries but it is not supported by the mathematical writings of the ancient Egyptians which have been deciphered up to the present time

It seems to have been due originally to a misinterpretation but the high standing of the work in which it first appeared and its elementary character naturally led to its wide adoption by other writers Since right angles can be constructed in the given manner it is obviously impossible to prove now that the ancient Egyptians did not use this method for this purpose, but the definite statement that they used it naturally implies that it appears in their deciphered writings and this is incorrect These writings contain sets each composed of three numbers which are in the proportion of 3, 4, 5 and were known at least as early as 2000 B C to satisfy the condition that the sum of the squares of the two smaller ones is equal to the square of the largest, but such examples of numerical relations are far removed from proving that the ancient Egyptians were familiar with the corresponding geometrical properties The deciphered writings exhibit no definite evidence to the effect that they recognized the correspondence between these arithmetical and geometrical relations

The crowning mathematical achievement of the ancient Egyptians is the so called formula for the volume of the frustum of a square pyramid In a strict sense of the term neither the pre Grecian mathematicians nor the ancient Greeks themselves developed a mathematical formula The pre Grecian mathematicians had neither rules nor formulas but gave merely numerical examples which correspond to formulas The ancient Greeks had rules but no formulas, since the mathematical language was not then sufficiently developed to express results in modern formulas This could not be done until the people of western Europe had created the needed mathematical language at about the close of the middle ages Such questions belong to explicit mathematical history and hence they are not controversial It is only the implicit mathematical history that has given rise to controversies

G A MILLER

UNIVERSITY OF ILLINOIS

ONE ASPECT OF THE LONGEVITY PROBLEM

PRELIMINARY experiments on the giving of dilute sodium rhodanate solutions continuously to rabbits and chickens instead of water were reported on at the Cleveland meeting of the National Academy of Sciences, November 20, 1934 The work was financed in part by a grant from the Heckscher Foundation for the Advancement of Research established by August Heckscher at Cornell University These preliminary results indicate that sodium rhodanate improves the general health and lessens the nervous irritability of rabbits and chickens, thereby increasing their resistance to coccidiosis, respiratory infections and infectious leukemia There is reason to believe that a number of other diseases should not be so acute and fatal in animals treated with sodium rhodanate Of even more interest to us are the general conclusions which we believe that we are justified in drawing from these experiments and from our preceding work, a great deal of which is still unpublished

In the last twenty five years the probable length of human life has increased materially, thanks to medical science, but the change has been due very largely to a decrease in mortality among infants and children The probable length of life of a man of forty five has not been increased appreciably in the last quarter century Medical science has failed so far as such men are concerned

The colloid chemist comes in where the medical man drops out Sodium rhodanate and drugs of that type will minimize the physical effects of worry and will decrease the tendency to nervous breakdowns not caused by definite pathological conditions Sodium rhodanate increases the resistance of the living organism to infection by inducing better health Drugs of this type will not cure progressive lesions and sclerotic conditions, but they will retard the aging of the colloids of the body and will thereby delay the onset of such pathological conditions If every human being of forty five or over, for whom sodium rhodanate is not contra indicated, would take sodium rhodanate regularly for the rest of his life, we predict an average increase in the probable length of life of at least two years, provided the medical men will cooperate

We can not prove this prolongation of life now because every application to a foundation for money for research is referred, inevitably and properly, at some stage to a medical man and turned down by

him, inevitably and improperly, on the ostensible ground that the matter is not yet proved and therefore should not be supported If it had been proved, we should have been asking for money for some other purpose

A few medical men have been interested in our point of view We thank them for this and we hope that we may retain their sympathy in the stormy days that are to come

The medical profession, as a whole, is hostile to us, due to the attitude of those who should be the leaders So far as we know, not a single medical school or hospital has shown any active, intelligent interest in our work Two deans of medical schools have been good enough to make clear to us what the attitude of the medical profession is We have confirmed the following views independently

(1) Nothing good along lines of research involving living tissue can come from chemists

(2) Our line of reasoning is foreign to the medical mind and the authorities in the medical profession consequently consider our work and conclusions so unsound that it would be a waste of time to check either

(3) Since our experimental work is bad by hypothesis, one hundred or even five hundred cases would not be convincing, because one hundred or five hundred experiments done badly have no cumulative value

(4) Since our conclusions are unsound by definition, any doctor confirming our findings proves thereby that he is incompetent to do that type of research

At Beaufort, N C, Miss Koehring has shown that treating a starfish with ether or chloroform causes a reversible agglomeration of some of the proteins in the walls of the stomach Though this experiment can presumably be confirmed by anybody who is interested, the experimental results carry no weight in medical science against an *obiter dictum* The theory of Claude Bernard on anesthesia is to be considered wrong, not because it is wrong but because we have shown it to be a first class working hypothesis

Pauli's work along similar lines to ours has stood uncriticized for about thirty years, but is now automatically and officially worthless because it confirms our results

Our answer to the medical profession is simple It is up to them to clean house From now on it is a fight to the finish between the medical profession and ourselves There can be only one outcome to this contest The medical profession will lose The medical profession—or their unwise leaders—can and probably will retard progress, but they can not prevent progress completely

We challenge the medical profession to run fair tests of our treatment, with all experimental details released, on certain forms of alcoholism, insomnia and sciatica These are selected because even a medical man should get good results the first time The medical profession does not dare make these tests, because the results would show that we are right The medical profession can not admit that they do not dare to make these tests, because that would prove that the medical leaders are wrong The medical profession can not treat us with dignified contempt, because that is confession in view of the fact that this is not a commercial venture

If all data are released of any tests that are run, we can and will expose the faulty technique or the misunderstanding, which will probably occur in the future as it has in the past Individual medical men have said that it would take twenty years to test our views properly That is nonsense so far as we are concerned If sufficient material is available, tests satisfactory to us can be made in a few months There will come a time when the intelligent medical men—and there are such—will resent the false position into which they have been led by following the priests of Baal

WILDER D BANCROFT
ESTHER C FARNHAM
JOHN E RUTZLER, JR.
CORNELL UNIVERSITY

A PASTEURELLA-LIKE MICROORGANISM IN THE BRAINS OF HORSES SUFFERING FROM SO-CALLED CORNSTALK DISEASE

STUDIES at the Laboratory of Animal Pathology and Hygiene of the Illinois Agricultural Experiment Station on the etiology of an acute encephalitic disease of horses, referred to as cornstalk disease, cerebro spinal meningitis, staggers, blind staggers, meningitis, forage poisoning, etc, which occurred in Illinois during the fall of 1934, have given consideration to the presence of filterable agents, pathogenic molds and bacteria, as well as toxic chemical substances For the reason that such investigations require long periods of time for their completion, preliminary observations on the bacterial flora of the brains of affected horses are being reported, in part, at this time

Animal inoculations of the brain tissue suspensions in saline of two horses, together with the inoculation of five mixed cultures made from the brains of horses, yielded pure cultures of a pathogen possessing the characters of the pasteurella group The seven horses supplying material for these studies originated on seven different farms in three counties In six of the seven brains, visible areas of degeneration were encountered in the cerebrum Pasteurellosis infection has long been recognized as an etiologic factor in so-called cornstalk disease of cattle, but so far as the

writer has been able to determine, pasteurella equiseptica-like strains have not heretofore been isolated from the brains of horses suffering from so-called cornstalk disease.

ROBERT GRAHAM

UNIVERSITY OF ILLINOIS

A FRESH WATER SPONGE FROM SOUTHERN CALIFORNIA

FRESH-WATER sponges are rare in California, largely because of the scarcity of permanent streams. This is especially true of so-called Southern California, south of the San Gabriel or Sierra Madre mountains It appears, in fact, that hitherto no fresh-water sponge has ever been reported in this part of the state. On October 13, 1934, a student, Mr. Donald Nelson, found and a few days later brought to my attention such a sponge, *Asteromeyenia plumosa* (Weltner) Annandale. This is a rare species, originally described from Kinney County, Texas, and having as its only other reported locality Shreveport, Louisiana. The two Southern California specimens were each about the size of the palm of a man's hand, growing in a cement weir box which is part of an irrigation system, near Fullerton (just southeast of Los Angeles). The source of water is the Santa Ana River, which runs deep in winter, but is often dry in the summer. The specimen collected was well provided with gemmules and is typical to the most minute degree of the species as previously described.

M. W. DE LAUBENFELS

ALTADENA, CALIF.

SCIENTIFIC BOOKS

ELECTROLYTES

Electrolytes. By HANS FALKENHAGEN, professor in the University of Koln. Translated by R. P Bell, fellow of Balliol College, Oxford. Royal 8vo, pp. 346. $9.50. Oxford University Press.

THE motif of this comprehensive monograph is "not only to give the most important theoretical principles in the domain of electrolytes, but also to give the reader some idea of methods of experimental investigation and the reliable experimental results obtained." This statement obviously implies the notable advances made by Debye and his followers, but readers interested in topics closely allied to electrolytes will find the English translation extremely valuable.

Although the present book is for the greater part simply a translation of the 1932 German edition, it has been revised in consultation with the author to bring it into line with the experimental and theoretical advances of the past two years. The added topics embrace: theoretical and experimental work on transport numbers, Onsager's treatment of the dissociation field effect, the extension by Fuoss and Kraus of Bjerrum's theory of ion-association and finally an appendix by R. H. Fowler illuminating R. H. Gurney's application of quantum mechanics to electrode processes.

The author does not assume that, since the basic subject-matter is a time-honored one, all readers will be prepared to comprehend the intricacies of such specialized topics as those just enumerated. To this end, he devotes the first six chapters to an elementary and well-organized presentation of the problems of the equilibrium state and the irreversible process of conductance in a way which should prove helpful to one who is approaching the subject for the first time.

The thermodynamic treatment follows closely the classical methods of Planck, modified, of course, to embrace the activity concept of G. N. Lewis. Although disciples of the American and Danish schools of physical chemistry would doubtless prefer a more concise and less labored development, nevertheless the thermodynamics is eminently sound and consistent. In chapters 7 to 10, the principles of the Debye-Milner theory are developed pictorially, then mathematically and finally tested in their limiting forms as explanations of the solubility influences of ions upon ions, the salting-out effect of ions upon neutral molecules, heats of dilution and dependence of conductance upon concentration (Onsager's theory), viscosity, frequency and field strength (Wien effect).

The author has made notable contributions, in collaboration with Debye, on the intricate problem of the frequency and field strength effects, and hence is well qualified to present the subject. Although there is now available a wealth of experimental data supporting the theory in its numerous aspects, the author selects examples which not only substantiate his case, but give appropriate credit to pioneer workers in the field.

The title of Chapter 11, "More Concentrated Solutions," may prove somewhat disappointing in that one who has not been dealing with the subject might expect that the concentrated solutions of industrial importance are to be discussed. As a matter of fact, the term refers primarily to that all too dilute range of concentrations for which it is necessary to consider the ion-size parameter "a" as a correction to the limiting laws—to account for the specific effects of individual electrolytes. The Hückel formula which is based upon the assumption of specific linear decrease of dielectric constant with concentration and which reproduces the experimental results of really concentrated solutions (0,1 to 4 M) is dismissed as little

more than "a convenient empirical formula for interpolation" (p. 273). This summary dismissal may eventually prove to be unnecessarily severe; nevertheless, it should operate as a warning for those writers who have been using the formula indiscriminately without cautioning their readers that the dielectric parameter has at present little or no physical significance.

The Gronwall-La Mer solution of the Poisson-Boltzmann equation, which disposes of the absurd result of "negative ion diameters"—frequently encountered in applying the original theory to high valence ions or low dielectric solvents—is presented in detail for practical application. The close relationship between the Gronwall-La Mer treatment and the Bjerrum hypothesis of ion-association is set forth rather more clearly than has been customary at the hands of some of the recent converts to the modern theory of electrolytes. The problem of "true" degree of dissociation for high concentrations is discussed in this chapter in the light of refractometric and Raman effect data, while Bronsted's "Principle of Specific Interaction" is accorded a highly appropriate presentation.

A conspicuous feature is the judicial attitude which the author assumes in presenting the work of other workers, even when they differ radically from his own views; also the complete nature of the literature references to date of publication (May, 1932). For example, the several possible interpretations of the existing e.m.f. and calorimetric data on the heats of dilution and heat capacities are presented in the light of their obedience to the limiting law and incomplete dissociation. Considering the difficulties inherent in so comprehensive an undertaking, the translator has succeeded in most instances in incorporating the more significant additions to the close of 1933.

At that time only Onsager's masterly criticism of the statistical foundations of the theory ("Symposium on Electrolytes," *Chemical Reviews*, August, 1933) was available. Since then conflicting papers by Halpern, by Kirkwood and by Fuoss dealing with the question of integrability conditions, fluctuation terms, etc., have appeared in the *Journal of Chemical Physics*. The theory is certainly not unassailable from a critical statistical view-point, yet the general excellent agreement with experiment makes it appear highly probable that these statistical weaknesses may not prove serious, after all. Under the circumstances, the author and translator undoubtedly acted wisely by deleting R. H. Fowler's earlier critique and reserving judgment on these vexing questions, even though it is done at the expense of disappointing the expert.

The reviewer has found no serious errors or misprints. The printing and format conform to the high standards of the Oxford Press. However, it is a pity that the editors of the Physics Series do not insist that their authors include an adequate subject and author index. The abridgement from the 7-page author and 4-page subject index of the German edition to the inadequate single page subject index will seriously interfere with the full use of this well-documented book as a convenient source of reference.

VICTOR K. LA MER

COLUMBIA UNIVERSITY

REPORTS

THE ELIHU ROOT LECTURES OF THE CARNEGIE INSTITUTION OF WASHINGTON

THE establishment of the Elihu Root Lectures by the Carnegie Institution of Washington provides an opportunity for a broad outlook on science. Dedicated to a distinguished statesman well known for his appreciation of scientific research, these lectures focus attention on the influence of science upon human thought and upon our attitude toward life. For these lectures speakers will be selected from those who are eminent in their respective fields and have themselves contributed to the development of scientific thought.

The first lecture was delivered by Dr. James R. Angell, president of Yale University, on December 4. The subject was "Popular and Unpopular Science." The speaker presented an analysis of the reasons why the modern social order so readily accepts the superficial and the incorrect, and fails to appreciate or utilize the truly significant advances of science. In discussing the connection between science and the dominant forces of society Dr. Angell stated:

> . . . If science in any important sense is to affect the intellectual fabric of civilization, then through education it must be woven into the essential fabric of our culture. To do this will require at best several generations and not a few profound changes in educational method and objectives.
>
> Among other things, it will certainly mean a wide-ranging program of continuing adult education, for science grows so rapidly and its changes are so kaleidoscopic, that in no other way can adult intelligence keep abreast of its discoveries. To be sure, many individuals have intellectual limitations which will leave them inevitably strangers to the intrinsic implications of science. But limitations of this kind face all educational systems and at every level. In any case, what is really important is not so much the prevalence of accurate, up-to-date scientific knowledge as it is the ingraining, deep in the habits of thought of the people, of a careful, critical—even skeptical—scrutiny and analysis of every situation,

and with a correspondingly conservative process of inference and generalization, so that intelligence may have really free play to make its fullest contribution to the changing social order

And in conclusion

> Nor should it be forgotten that many of the highest and purest values in life lie within the area of feeling and emotion Beauty is not the child of science, and neither its creation or its enjoyment waits upon scientific methods The world of ethics and religion and spiritual insight is also beholden in part only to science To impregnate our culture through education with a genuinely scientific spirit should therefore exercise no malign influence on these other integral elements of a civilization

The second lecture was delivered on December 11, also at the U S National Museum, by Dr H A Spoehr, chairman of the Division of Plant Biology of the Carnegie Institution on The Nature of Progress in Science" Dr Spoehr illustrated the methods of scientific research by describing the steps taken in investigating the process whereby green plants under the influence of the sun's rays convert inorganic compounds into substances used by man and contrasted the mode of thought employed in the field of science and that which prevails in the field of social endeavor, saying

> Intrinsically there is no reason why there should be any difference in fundamental development in different fields of human endeavor, such as appear to be in the fields of social activity and those of natural science They are the products of the same culture of the same human stock and of the same stage of development This how ever, seems certain, that natural science has been tremendously stimulated by the realization that continuous change must be expected of all things and that such change is not unrelated to past experience

He emphasized especially the necessity, in attacking any problem, of analyzing the various factors that are involved and of attempting to define these in terms of existing knowledge To quote Dr Spoehr

> This is frequently the most difficult and discouraging stage of the scientific approach to a problem and involves a laborious and time consuming period of fact finding and sifting of data The first step is frankly to recognize that there is a problem This in itself involves a large element of intellectual honesty and avoids *much haphazard guessing and fumbling opportunism.*

Moreover, in speaking of one of the most characteristic and fortunate aspects of the development of scientific thought, Dr Spoehr said

> The immensity of its problems has been very generally recognized by its adherents The constitution of matter, the forms of energy the nature of life are all subjects about which we wish to know more But science has attacked these problems in a stepwise manner It does not hope to arrive at ultimate truth by one master move or a single brilliant idea It has long realized that the development of concepts is a matter of evolutionary development and it has planned its attack accordingly One small and carefully planned advance has secured a position from which another advance could be made and so on step by step the development has been secure and remarkably rapid

F F B

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON d-XYLOMETHYLOSE (5-DESOXY-XYLOSE)

OUR laboratory has been engaged for a considerable time in the study of methyloses In view of a very recent publication by Swan and Evans[1] on the preparation of l arabinomethylose (l-5, desoxyarabinose), we wish to report on the synthesis of d xylomethylose (d-5, desoxyxylose) The sugar itself has not yet been obtained in crystalline form The syrup, however, has the correct composition

Calculated	C 44 75, H 7 5
Found	" 44 52, " 7 5

$[\alpha]_D^{20} = -2\ 16°$ (in ethanol)

Of this syrupy sugar three derivatives were obtained, two of which were crystalline

(1) *Mono-acetone Xylomethylose*

Specific rotations $[\alpha]_D = -20\ 99°$ (water, c, 3 047)
$[\alpha]_D^{24} = -18\ 22°$ (U S P chloroform, c, 3 046)

Melting point 69–70°, boiling point, 86–87°/0 2 mm

Analysis		
	Calculated	C 55 17, H 8 1
	Found	" 54 88, " 8 1

(2) *3 Acetyl Mono acetone Xylomethylose*

Specific rotation $[\alpha]_D^{24} = +2\ 55°$ (U S P chloroform, c, 3 136)

Boiling point, 79–80°/0 2 mm

Analysis		
	Calculated	C 55 55, H 7 4, CH_3CO, 19 91
	Found	" 55 47, " 7 8, " 20 70

(3) *d Xylomethylose p Bromphenylhydrazone*

Specific rotation, $[\alpha]_D^{20} = -26\ 05°$ (dry pyridine c, 2 38)

Softens, 65° melting point 69–70° (with foaming)

Analysis		
	Calculated	C 43 58, H 5 0, N 9.24, Br 26 37
	Found	C 43 78, " 5 1, " 9 05, Br 26 21

P A LEVENE
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THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH,
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[1] *Jour Am. Chem. Soc*, 57 200, 1935

A MERCURY PUMP FOR MAKING AND SUPPLYING A UNIFORM MIXTURE OF GASES

IN a study of the influence of gas storage upon the keeping quality of apples, the writers wished to subject small lots of fruit in five-gallon closed containers to various synthetic atmospheres; these atmospheres, varying in their percentages of oxygen and of carbon dioxide, to be supplied to the fruit at a uniform rate of flow and of concentration over any given period of time. In this experiment, where different artificial atmospheres were supplied to fruit samples without interruption over a six-month period, it was desirable to reduce the consumption of the various gases to a minimum consistent with the maintenance of uniform atmospheric conditions in the containers. The different atmospheres, containing 5, 10 and 15 per cent. of carbon dioxide and a corresponding reduction in the percentage of oxygen, were therefore supplied the containers at the rate of 100 cc each minute or only in sufficient quantity to give a complete change of air once in about six hours. This rate of exchange, which under a holding temperature of 42° F. proved sufficiently rapid to prevent the concentration of carbon dioxide in any of the containers from increasing at any time more than 0.3 per cent., required such small quantities of "air" that accurate measurement of the different gases by the use of a flow-meter presented difficulties. Thus, rather than employ this indirect method of determining volume by the measurement of differences in gas pressure, a motor-driven mercury pump was devised which accurately measured the volume of the different gases directly and supplied the resulting mixture in proper proportions to the different chambers. A diagrammatic sketch of this equipment is shown in Fig. 1.

Gas tanks, containing CO_2 and N, and the compressed air line, supplying the necessary O_2, were each fitted with the ordinary high and low pressure gauges. The latter were regulated from time to time to deliver each gas to a second regulator, a Murrill pressure controller, (a) at a pressure of from 1 to 2 pounds. After passing through this regulator, the gas flows under a 1½ inch water pressure, as recorded by the manometer (b) to a specially designed pyrex glass pipette valve (c). In passing through the inlet valve the above pressure nearly equalizes the resistance of the mercury in the bottom of the valve; hence by the time the gas reaches the measuring bulb (d) it is at approximately atmospheric pressure.

The measuring bulbs are alternately filled with gas and mercury by the action of a 6-inch cam (e) lowering and raising a leveling bulb of mercury (f). This pumping action of the mercury is set in motion and maintained by a 1,125 r.p.m. motor equipped with a 2,200 to 1 reduction. Under these conditions one complete stroke is made and one charge of gas delivered each 2 minutes.

The measuring bulbs, also of pyrex glass, were constructed 3 inches in height and of various diameters. The bottom stem of the bulbs was of 6 mm bore and the top stem of 2 mm bore. Approximately one inch of each stem was included in the volume of each bulb. With each stroke of the pump the mercury traveled 5 inches, filling the lower stem one inch as the air was drawn into the bulb and filling the upper stem one inch as the charge was expelled. By slightly raising or lowering the level of each bulb in relation to the height of the mercury in the leveling bulb, the difference in the bore of the upper and lower stem permitted any small adjustment in volume necessary to overcome the slight resistance encountered by the gas passing through the mercury in the bottom of the outlet valve. Before connecting the outlet valves to the small pipe line leading to the fruit chambers, which were in a 45° F. storage room some 15 feet distance from the pumping equipment, the correct volume of the bulbs was finally calibrated by displacing water in a burette. To secure a 200 cc charge of an atmosphere containing 5 per cent. CO_2 and 15 per cent. O_2, the capacity of the bulbs were CO_2 10 cc, N. 46 cc and air 144 cc.

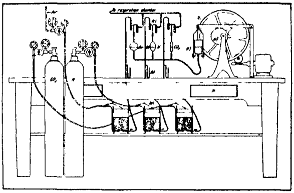

FIG. 1. Schematic diagram of mercury pump for furnishing a constant supply and a uniform mixture of gases to respiration chambers.

By duplicating the cams and the series of bulbs and valves, as was actually done, any set of conditions may be duplicated. By varying the relative proportions of the bulbs measuring each gas, several different atmospheres may likewise be obtained. Changes in the gear ratio and in the actual size of the equipment make possible its adaptation to a wide range of conditions.

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SPECIAL ARTICLES

ELEMENTS AND GENERAL JUPITER PERTURBATIONS OF TEN WATSON PLANETS[1]

THE program initiated by the board of trustees in accordance with the wishes of James D. Watson for the theoretical and numerical determination of the elements and general Jupiter perturbations of the twenty-two minor planets discovered by Watson is now completed. The results for twelve minor planets are published in Memoirs, Volume X. General expressions and tables for perturbations of planets belonging to the Hecuba Group, which have a mean motion of approximately twice that of Jupiter, were published in Volume XIV, preliminary to the investigation of the Watson planets of that type. Subsequently, papers have been presented to the Academy giving the results on five critical cases of the Hecuba Group (this paper includes a brief report on two other critical cases of this group). In view of the complicated theories involved, publication was deferred until opportunity had presented itself to test the results on recent observations, decades remote from the oppositions which furnished the basic osculating elements. For the twelve planets already published, the Berlin Rechen-Institut has, from year to year, included predictions in its *Kleine Planeten*, based on the perturbations contained in Memoir X. It has already been reported at the fall meeting of the Academy at Berkeley in 1930 that the predictions have held so well, although originally limited to thirty years, that the tables have been carried forward for another fifty years.

During the past year it became possible to test thoroughly the results of the five most critical cases of the Hecuba Group by recent observations. The departures were less than had been expected theoretically, considering that the perturbations of Saturn, which may be added any time if necessary, are not included. These results have been published in abstract in the October number of the *Publications of the Astronomical Society of the Pacific*. It is now possible to report to the Academy that the value of the investigations on the Watson planets, conducted under the auspices of the board of trustees, is thus established.

In illustration of the size of the perturbations involved in these investigations I may cite one striking case, that of (175) Andromache. The perturbation for the 1935 opposition in the mean anomaly is in excess of $-26°$, which would make the disturbed position geocentrically some 52° different from the undisturbed position. For an ephemeris extending from Aug. 18 to Oct. 5 this component of perturbation, alone, changes by 1,625″. In spite of these large perturbations an observation in 1932 left outstanding differences of only $-0^{m}.32$ and $+2'.04$ although Saturn perturbations are not included. This result is the more gratifying as the last opposition on which the basic elements were based occurred in 1907, a quarter of a century before the year for which the results were tested. The recent work of testing critical cases was done under my general direction and under the more immediate direction of Dr. Sophia H. Levy by Dr. C. M. Anderson and Mrs. Barbara P. Riggs.

The ten Watson planets on which the present report is made, with their approximate mean motions as listed in *Kleine Planeten*, 1934, are: (79) Eurynome, 928″; (94) Aurora, 634″; (100) Hekate, 650″; (104) Klymene, 636″; (106) Dione, 625″; (121) Hermione, 552″; (132) Aethra, 845″; (150) Nuwa, 690″; (168) Sibylla, 572″; and (175) Andromache, 610″. On all these the work was done at Berkeley, except for (132) Aethra. For this planet, which had been lost for many years, results by another investigator have been adopted.

The following is a brief description of the principal features of the investigations for each planet:

(79) *Eurynome*, 928″: Investigations on this planet were originally made under the direction of Simon Newcomb by E. Becker, who developed general perturbations by Hansen's method on the basis of elements by Lachmann, osculating in 1884. The elements were based on eleven oppositions, 1863–81, with special Jupiter perturbations. After Becker had computed first order general perturbations with Hansen's method, representation of positions was begun by Eichelberger and revised and continued at Berkeley. The final work involved revision of the perturbations, with an improved mass of Jupiter, determination of empirical terms due to Mars, and correction of the elements on the basis of an arc of forty-six years, from 1863 to 1909.

(94) *Aurora*, 634″: Work on this planet led originally to uncertain results because of the inadequacy of available basic elements. New basic osculating elements from the oppositions 1867–1875 were made the basis of the application of the Berkeley Tables for the Hecuba Group. This process produced the desired results.

(100) *Hekate*, 650″: Investigations on this planet became complicated on account of the inaccuracy of the adopted basic elements, the slow convergence of the mean motion with successive revision of the perturbations by Hansen's method, and an unfortunate computational error. The perturbations were redeveloped on the basis of elements by Stark with Gaillot's Tables and Hansen's method. The convergence of the mean motion with revision of the perturbations was exceedingly slow, but a satisfactory value was ulti-

[1] Abstract of paper presented to the National Academy of Sciences, Cleveland, November 3, 1934.

mately obtained and was verified by application of the Berkeley Tables for the Hecuba Group.

(104) *Klymene*, 636″: Gratifying results were obtained with the Berkeley Tables.

(106) *Dione*, 625″: The difficulties involved were surmounted by application of the Berkeley Tables.

(121) *Hermione*, 552″: This planet was investigated by various methods and ultimately with the Berkeley Tables. The satisfactory outcome of the work on this planet proves that the tables are satisfactory at the extreme limits for which, theoretically, they were expected to be applicable.

(132) *Aethra*, 845″: The investigations adopted for this planet are by Hartog, who published mean elements from three oppositions, 1873–1924. The planet had been lost for nearly forty years. Hartog also published general perturbations by Jupiter from Bohlin's tables.

(150) *Nuwa*, 690″: General perturbations for this planet were developed by the Hansen-Hill method on the basis of osculating elements by Oppenheim, derived from five oppositions from 1875–1884. The final results are based on seven oppositions, from 1875–1899.

(168) *Sibylla*, 572″: With elements by v.d. Groeben, based on four oppositions from 1876–1883, the general perturbations by Jupiter and mean elements were obtained with the Berkeley Tables.

(175) *Andromache*, 610″: As referred to above, this is the outstanding case as regards magnitude of perturbations of minor planets. It was the motive for constructing the Berkeley Tables for the Hecuba Group, and was successively conquered by their application.

Thus of the planets awaiting publication, six are of the type that required the application of the Berkeley Tables in order to obtain a satisfactory representation of observations from the date of the first discovery in 1857 to the present time. Since there exist several hundred planets of this type, the way is thus clear for the development of their general perturbations as a means of long range prediction of their future positions.

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VITAMIN B_2 (G) AND CANINE BLACK TONGUE[1]

The cause of black tongue, an acute disease of dogs characterized by stomatitis, diarrhea and frequently by a fatal outcome, remains obscure in spite of the very considerable number of experimental studies of the subject. The disease has been held in turn to be infectious, to be due to an insufficient intake of carotin[2] and to be caused by diets containing inadequate amounts of iron.[3] The most widely held hypothesis, however, has been that advanced by Goldberger and his associates.[4] They were able to cure and prevent the disease by feeding certain foods which are rich in their content of the vitamin-B complex. The effective agent in the materials fed was found to be resistant to autoclaving, a fact which served to differentiate it from the heat-labile, antineuritic vitamin B_1. It was then shown that a similar heat-stable food constituent was required for the growth of rats. Because of the similarity in distribution and resistance to heat shown by these two accessory food factors, it was inferred that they were identical. Furthermore, because of the symptomatic, geographic and etiologic likeness between canine black tongue and pellagra of human beings, the suggestion was advanced that pellagra was caused by a lack of the thermostable food factor, termed at first vitamin PP, and later vitamin B_2 or G.

Experiments have been performed in this laboratory which were designed to test, under standard conditions, the various theories concerning the cause of canine black tongue. The diet described by Goldberger as No. 114 was employed and regularly caused symptoms in from 6 to 8 weeks. Iron and carotin were both found to be therapeutically and prophylactically ineffective, but autoclaved yeast extract was entirely effective. Since Miller and Rhoads[5] had shown that the same extract was not high in its content of vitamin B_2G, and were unable to cause black tongue by feeding diets devoid of that vitamin, a direct test of the vitamin B content of the diet producing black tongue was suggested. Such a test has been made, and results show it is possible to maintain a normal rate of growth in young rats fed only the diet producing black tongue—conclusive proof that it contains vitamin B_2G in considerable amounts.

Since lack of the thermostable vitamin required for rat growth does not cause black tongue, and since the diet producing the disease contains that vitamin, it may be inferred that black tongue is not due to a deficiency of vitamin B_2G, but rather to a lack of some factor as yet unidentified.

C. P. Rhoads
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THE RETRACTOR MUSCLE OF THE POUCH IN THE GEOMYIDAE

THE retractor of the cheek pouch in the pocket gophers (*Geomys bursarius, Thomomys bottae, Thomomys bulbivorus*) and in the kangaroo rat (*Dipodomys spectabilis*) has been thought to represent the platysma,[1 2 3] although it is more extensive and has a more caudal origin than in other mammals It arises, in the pocket gophers, from the superficial layer of the lumbodorsal fascia and from the last two thoracic vertebrae, superficial to and coextensive with the spinotrapezius It runs parallel with the latter to the spine of the scapula, but, instead of attaching to the spine, it continues craniad to insert on the caudal and dorsal margins of the pouch

The part of the muscle cranial to the scapula receives branches from the facial nerve, while the more caudal portion receives, in the four species named above, the terminal branch of the accessory To determine whether or not the accessory nerve actually supplies the muscle, it was suggested to me by Professor A Brazier Howell, of Johns Hopkins University, that stimulation experiments be performed An induction coil and a bipolar electrode were used in the experiments, which were repeated in four individuals of *Thomomys bottae* The current was the weakest that would induce contraction of the facial muscles when the facial nerve was stimulated

The skin of the living anesthetized animal was cut, ventral to and parallel with the retractor muscle, and deflected This exposed the shoulder and neck region, the facial nerve and the terminal branch of the accessory The facial nerve was stimulated near the stylomastoid foramen the facial muscles, including the cranial portion of the retractor muscle, contracted The facial nerve was then severed to prevent possible reflex action by it

The terminal branch of the accessory nerve, as it emerged from the ventral border of the spinotrapezius to pass to the retractor muscle, was stimulated the caudal portion of the retractor contracted, but none of the adjacent muscles did so The accessory nerve was then exposed as it emerged from the jugular foramen, by cutting the origins of the sterno- and cleidomastoid muscles and of the posterior belly of the digastric The nerve was stimulated at this point the trapezius and retractor muscles contracted, but none of the adjacent muscles reacted In two individuals the accessory nerve was cut distally from the place of stimulation the retractor muscle did not contract In two other individuals the nerve was stimulated through the trapezius the fibers of this muscle which were in contact with the electrodes contracted, but not the muscle as a whole, while the retractor muscle contracted as previously The cut end of the accessory nerve at this place was stimulated with similar result

These experiments appear to confirm the anatomical findings and to show that the caudal half of the retractor muscle of the pouch is innervated by the accessory, while the cranial portion is supplied by the facial nerve Consequently it seems probable that the caudal portion has been derived from the trapezius, a conclusion which the origin and topographical relationships of the retractor muscle tend to strengthen If this be true it is the only case to my knowledge in which the trapezius contributes to the dermal musculature

In the ground squirrel (*Citellus richardsonii*) the platysma attaches to the spine of the scapula The fibers of the spinotrapezius run in the same direction as those of the platysma, and the more superficial ones are separated from the latter muscle only by fascia Should these fibers become split off from the deeper part of the spinotrapezius, and should they and the platysma become free from the spine of the scapula, the resulting compound muscle would be similar to the retractor muscle of the pouch in the Geomyidae (in the inclusive sense) Similar changes have taken place in the digastric muscles of some mammals and it seems reasonable to conclude that such has been the history of the retractor of the cheek pouch in pocket gophers and their allies

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SCIENCE

VOL. 81 FRIDAY, FEBRUARY 15 1935 No 2094

SCIENCE A Weekly Journal devoted to the Advancement of Science edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster Pa Garrison N Y

Annual Subscription $6 00 Single Copies 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

A TAXONOMIST'S EXPERIENCE WITH HYBRIDS IN THE WILD[1]

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IT is with much trepidation that I approach this subject in an audience that is doubtless more deeply informed on the recent phases of genetics than I The only justification for such audacity is that possibly some of the observations from another angle may supplement the splendid work of modern students in that now highly specialized field I shall not attempt, however, a very deep genetical discussion of the observations made

In his every day experience with plants in the field the taxonomist is accustomed to think of the species in certain groups as clear cut and easy to work with, while other groups are difficult and the species more or less confused with no sharp boundaries Much thought has been given at different times to the question as to why there is this difference between groups and what is its true phylogenetic significance Long ago among the special creationists there seemed to be no explanation other than that at the moment of creation the plans for these difficult groups had not been sufficiently worked out and perfected Following the general acceptance of the theory of evolution, it seemed that in certain groups species were perhaps in the making through active variation with the lines not clearly drawn as yet by natural selection The more confused groups were therefore the newer groups. There still seems much reason for thinking this to be true in a general way

That hybridity played any important part in causing the difficulty of species delineation in these groups was given little attention and rarely if ever suggested The occurrence of hybrids in the wild was, in those days, thought to be a rather rare occurrence In

[1] Address of the retiring vice-president and chairman of the Section for the Botanical Sciences, American Association for the Advancement of Science, Pittsburgh, December, 1934

Gray's Manual (Edition 5), we find hybrids scarcely mentioned except in one genus, Quercus, where 5 were listed. In the 6th edition this had been increased to 9, and 9 hybrids in Carex were discussed. In this edition also mention was made of numerous hybrids in Salix. At that time there seems to have existed a rather indefinite prejudice against the hybrid. The hybrid tended to disorganize and do violence to the orderly classification of nature. So few were recognized, too, that the burden of proof was always with him who assumed the hybrid explanation. The matter was still more complicated by the lack of criteria for recognizing hybridity and to some extent also by the taxonomist's unfamiliarity in many cases with the behavior and characteristics of hybrids in cultivation. Some taxonomists apparently held the view point that legitimate species should be difficult to cross and therefore that wild hybrids should not be expected.

With the discovery of Mendel's studies on peas, the whole outlook toward hybridity began to change. These studies stimulated enormously an awakening interest in the problems of inheritance and the whole modern science of genetics is the outcome. Along with this too was an awakened interest in the improvement of cultivated plants by breeding methods. One general result has been a more or less changed regard for the hybrid itself and it is no longer the outcast that it formerly was, but is full of interest as exhibiting some of the interesting and vital discoveries in heredity. In fact one author, Lotsy, has gone so far as to suggest the all importance of the hybrid as the only source of new species in nature.

At about the time that Mendel's work was discovered by De Vries and others I became interested in the taxonomy of the genus Amelanchier, which presented forms in the region where I was then living that were at variance with the treatment of the genus in the different manuals. A wealth of forms was found there in central New York, but no satisfactory disposition of them could be made. Some years later, on removing to the vicinity of Boston, the same experience was repeated. Two summers spent in Newfoundland at about this time furnished a similar experience. In this latter country Amelanchier was abundant, but it seemed almost as though no two individuals were the same. A certain botanist who had given some attention to the genus stated to me that he seriously doubted whether species in the accepted sense existed in this genus at all. This general uncertainty induced me to seriously undertake a study of the genus to see if it were possible to discover the actual situation. Besides notes made in the field, more than a thousand herbarium specimens of East American Amelanchiers were assembled from different herbaria, and much time for a year was spent on the problem. Many sortings of this material were made, based on different structural characteristics, but at first without clarifying the situation.

The increasing interest in hybridity due to Mendel's work caused me at length to wonder whether crossing could have anything to do with the Amelanchier situation. So finally an attempt was made to sort the specimens as though there were a number of true species among them which when crossed with each other in pairs would account for the remaining forms. It was assumed that the true species when found would have certain characteristics, namely, they would probably each offer one or more characters peculiar to that species individually. Each species would also be expected to show a more or less normal range corresponding to the geographical regions of the country, as shown by the ranges of species in other groups. Also each would probably show certain soil and other habitat requirements, a certain period of flowering, and in other ways behave like species in other genera.

It was assumed also that hybrids would show certain peculiarities. They would not ordinarily present any new characters, but would simply recombine characters found in the two parent species, or in some cases show a blend of characters. The range too would tend to be small, as the hybrids presumably would not have had time to spread over wide areas, and thus their ranges might not follow the geographical areas, as possibly they had not spread that far. Also, hybrids would not be found outside the range of the two supposed parents.

Several sortings were made on this basis, but still with unsatisfactory results as far as the above points were concerned. Then suddenly a sorting was made that gave six piles of specimens. Each of these piles was essentially uniform and showed all the characteristics of a true taxonomic species as judged by the criteria just mentioned. In addition, there remained a seventh pile with quite different characteristics, it was not homogeneous as to character, it did not show new characters not present in the other six piles, and as far as distribution was concerned it was a mass of heterogeneous material. All the specimens in this pile, however, could be interpreted as crosses between some two of the other six piles.

We had then a rational disposition of the material, the first so far obtained. Here there were six good species similar to those in other groups, and the remaining material could be interpreted as hybrids of these species. The hybrid group, to be sure, was larger than might seem reasonable in nature, since it comprised about one third of the whole number of specimens. This, however, could be explained by the fact that while some of the six piles had been recognized before as common species and were familiar to

many collectors, all the hybrids were peculiar unidentifiable specimens and therefore were collected much more frequently than their comparative abundance in nature would lead one to expect

Here we have an interpretation of hybridity based on what is really circumstantial evidence Of course, the surest way to determine whether a plant is a hybrid is by breeding it to determine whether the characters behave in succeeding generations as hybrid characters should I hear some of you ask why this has not been done Most groups studied for revision by the taxonomist cover wide areas of country which because of time and cost, he can visit only rarely and perhaps then not at the exact season for critical study of his group He is forced, therefore, to depend to an undue extent on herbarium specimens These obviously can not be bred, and indeed frequently the locality from which a particularly interesting plant came can not be visited The only recourse is to depend upon circumstantial evidence of the sort just outlined However, this does not mean, it seems to me, that such evidence and the conclusions drawn are necessarily of no value In the few cases where breeding has been done, the original interpretations of the taxonomist have been generally supported But if the plants can not be bred it is still often very helpful to visit the locality from which a supposed hybrid was obtained We may find not only the necessary parents but also other hybrid individuals showing other combinations of the parental characters Some of these may be brought home and themselves bred Also artificial hybrids between the supposed parents made in the garden will furnish material for comparison Breeding, however, requires a certain special technique and space for growing the plants—requirements which render breeding by the taxonomist often very difficult After all, in the study of large groups chief dependence will still have to be placed on information gained from herbarium specimens It has been suggested, to be sure that hybrids may be told by the proportion of sterile pollen, and since that could probably be determined, at least roughly, in herbarium specimens, it might be an additional source of evidence It is my belief, however, that investigations have tended to show this criterion to be of little use Many apparently normal species often show as high as 50 per cent sterile pollen (Erlanson on Rosa) while some hybrids have good pollen Ecological conditions, also, appear to affect the viability of the pollen [2]

Since the work on Amelanchier, the same problem has been met in the study of two groups of white asters The same conditions were encountered, the same methods used, and the same conclusions reached as in the former case In each of the groups of asters three or four species were found, together with a mass of specimens which could be reasonably accounted for only on the assumption that they were of hybrid origin with these species as parents As in Amelanchier, the number of such hybrid specimens in the herbarium was greatly in excess of what one would expect from observations in the field, and the explanation is probably the same as in that case

While these three studies have seemed to lead directly to the belief that hybridization in nature is a common phenomenon, other studies on other groups would seem to lead to the opposite conclusion A revisionary study in two groups of Carex has shown no signs of hybridity Neither were signs of hybridity found in the *Eupatorium purpureum* group nor in Galium Hybridization in the wild is therefore much more frequent in some groups than in others It would seem that the Rosaceae in particular are liable to hybridize and other taxonomically difficult genera in this family such as Rubus Rosa Crataegus and others will probably be found to offer many cases of natural hybrids

The query now arises Are hybrids constantly produced in these groups and, if not what are the controlling factors? My experience tends definitely toward the conclusion that between certain species a great burst of crossing may occur locally all at once, and that this may or may not continue thereafter for a period of time Lotsy in his field studies in South Africa has reached essentially the same conclusion Over a limited area one will often find abundant hybrid individuals showing all manner of combinations of the characters of two parent species The lay botanists get the impression that here the genus is 'running wild" Elsewhere over large areas, even miles in extent, there may be no evidence of crossing whatever

But what causes plants to hybridize thus locally and suddenly? My own observation seems to indicate that disturbance of the environment has something to do with the matter, and on this the following cases may throw some light In Newfoundland a railway crosses the island Near the railway the forest has been largely destroyed by fire or through logging operations Tracts miles in extent are covered with dead brush and dense scattered thickets of scrub growth Amelanchier is common in this region, but taxonomically it was found to be a mess, as almost every individual seemed different from its neighbor In less disturbed areas the plants were more uniform In the detailed study of this genus already alluded to, it appeared that many of the plants in the disturbed areas were hybrids, and the more uniform strains in

[2] See C L Huskins, SCIENCE 69 399, 1929

the less disturbed regions were true species found generally in eastern North America

Again, on the Blue Hills south of Boston, the forest has largely disappeared Frequent fires have ravaged the region, and when visited several years ago presented alternating areas of bare rock, brush and open thicket Amelanchiers were common, but few individuals were like any known species or like each other Here also a peculiar micropetalous form occurred, previously noted by Dr Robinson Studies seemed to show that these aberrant forms were hybrids of three species occurring in the neighborhood of which two were dry ground species and one an inhabitant of the swamps at the base of the hills The micropetaly was due apparently to the effect of the fire, probably on the roots

In eastern Maine near Pembroke Rubus was very abundant In one locality the railway ran for a long distance through a lowland piece of woods The forest came up to the right of way which latter was kept cleared and mowed each season Close to the track the ground was weeded frequently and therefore was very much disturbed Along the border of the weeded zone prostrate, semi prostrate and arching individuals of Rubus occurred in considerable numbers These were queer, many of them being unlike anything known to us In the mowed zone there were fewer individuals and they were less queer while over near the fence and bordering the woods the plants were for the most part, clearly straight species with which we were familiar Most if not all of these queer forms could be interpreted as crosses between the species near the woods as they seemed to show only combinations of characters existing in these species Not being a specialist in Rubus, I would hesitate to say that the aberrant forms were all hybrids, but they were very suggestive

Another genus that has caused no end of trouble to the taxonomist is Crataegus Here, in many parts of the eastern states, individuals of this genus occur often in very great numbers, forming extensive stands The wealth of form is frequently very great giving the impression at times that no two plants are alike These individuals have been treated very differently by different taxonomists Dr Sargent, in his account of Crataegus in New York State, listed about 218 species while Eggleston for the same area recognized only 38 species Sargent, it is said, refused to believe that hybrids occur in Crataegus, or occur but rarely, while Eggleston is inclined to admit that hybrids are frequent or at times common The species of Crataegus are chiefly pasture weeds in New York State, frequently destroyed by the farmer and subject to grazing by cattle They can be said, therefore, to live under disturbed conditions I suspect that the early botanist, before the country was settled, would have found no such wealth of form as exists to day

Hybrids in the field then tend to occur locally at some particular time and often in considerable abundance While the cause of this is still obscure, a very suggestive hypothesis would connect it directly with the disturbed conditions just mentioned It might well be that these conditions induce irregularities in the time of flowering If some flowers are produced earlier or later than the normal period for that species, then these flowers might find no pollen from their own species but only that from some other species whose flowering period was earlier or later, as the case might be Whether this is so has not been determined as yet In this connection it is interesting that one author at least has cited dichogamy, especially in dioecious species, as a stimulus to hybridization Obviously these suggestions here offered with regard to the time of flowering should not be given much weight until more evidence is at hand

As to the significance in evolution and in the species question of this hybridization in the wild much may be said and much has been said The literature of genetics contains many recent contributions to this subject but unfortunately there are as yet very discordant views At present there seem to be two generally accepted sources of divergence between parent and offspring namely, gene mutation and hybridity With the first we are not here concerned In regard to the second, there have been very different viewpoints ranging from the extreme view of Lotsy, who saw no other cause for variation, to that of those who have wholly doubted the importance of hybridity in the production of new forms in nature The old idea that hybrids are necessarily infertile is of course no longer held, as experiment has shown many cases of fertile hybrids Reasons for fertility and infertility have been determined in many cases, and in plants the connection with polyploidy has recently been stressed It is now known also that many hybrids may breed true, either as homozygous segregates or through connection with polyploidy It is known too that in some genera, as for instance in the *Rosa canina* group, breeding true may occur through an apogamous development of embryos in seeds borne by the hybrid But breeding true as recessives has been over-emphasized, it seems to me, as a cause of fixed races, as not all recessive characters are homozygous at the same time, and while one character has become pure many of the other innumerable characters going to make up the species concept are still heterozygous Of course eventually one may get individuals having the composition a b c d e f g h i j, etc, but the chance is small To be sure, if the plants were always

selfed the time required might not be so long, but few species are always selfed

While fixed races can thus probably be produced by crossing, the question as to whether new species are formed in this way is another problem, and the evidence is not at all clear as yet Are new characters thus created? Mendel in his experiments with peas obtained only recombinations of parental characters in the offsprings, and not new characters In many cases it is now known that blends occur To what extent they occur in nature is not yet clear Casual observation does not easily discriminate between blends and the recombination of numerous closely related characters Brainerd and Gershoy apparently found only blends in the F_1 generation of their violet hybrids, and often blends also in succeeding generations While in a sense blends are new characters, they do not step outside the morphological range of the two parents, and they are doubtfully permanent Where they occur they tend more toward a smoothing out of variation than toward wholly new forms While geneticists have discovered some cases where new characters have appeared in hybrids, as for instance in Bateson's sweet peas, in Emerson's corn plant colors and in the walnut comb of fowls, I am not yet convinced that it is a sufficiently common occurrence to account, even in geologic time, for the great morphological diversity in plants Many of the cases observed have had to do with color and not with structure, and are clearly due to the interaction of genes present in the parents rather than to new hereditary factors originating in the hybrids themselves

Another serious difficulty in the way, if we are to consider hybridity as an important cause in the origin of species, is the dearth of evidence that it so operates in nature I have already called attention to the situation in Amelanchier After the hybrids were recognized and segregated there remained six or seven good species with normal ranges coinciding in general with the geographical areas in eastern North America, and fitting in with the ranges of other plants The hybrids were usually local Circumstantial evidence, therefore, seemed to indicate that these true species had been in existence a long time, during which they had spread over wide areas, as for instance from Newfoundland to Georgia and Minnesota—over all the area having suitable habitat conditions They were old enough to have become more or less static as far as distribution was concerned The hybrids seem like swarms of bees, buzzing around for a time, only to disappear, leaving the fundamental species to continue through the ages

Professor Fernald has called attention to the fact that apparently in glaciated Nova Scotia only one weak species has been produced in the 25,000 or 30,000 years since the Wisconsin glaciation, and that in the glaciated coastal region of eastern North America *Bidens hyperborea* occurring in several isolated localities, has maintained its specific identity during this same period Though it belongs to a notoriously plastic genus, it has shown at the most only varietal deviations in these isolated habitats In fact a geographer is led almost inevitably to feel that nearly all our east American plant species go back to the glacial period and probably far beyond It can not be denied that species may have arisen through hybridity, quite possibly in the ways suggested by many geneticists, but one can not become very enthusiastic At least, it seems evident that species are not being formed every day, or even every year, or even every century, as some enthusiasts are inclined to think

What then, becomes of the hybrids that from the standpoint of geological time are being produced in hordes? This to me is one of the interesting problems in evolution, second only to the problem of the origin of species in the first place Geneticists have made suggestions in this connection There would be, for instance, much sterility which would limit the number of offsprings The hybrids would be free to cross again with the parent species in nature and homozygous recessives would be swamped These recessives too would be weak in the struggle for existence In these recessives, while they would be homozygous and recessive to one character they would often be not so to others unless after a very long period of time and then only in comparatively few individuals Most hybrids would tend to disappear therefore The occasional production of stable polyploids would reduce this general tendency but probably not to a marked degree These genetical explanations of disappearance seem not quite sufficient to wholly account for the phenomenon, and we must await further studies

One other problem remains in connection with wild hybrids How shall we treat them taxonomically? Many systematic botanists have been loath to recognize them at all, or to admit that crossing occurs in nature In recent years the belief in natural hybridization has greatly increased A rational outlook, however, has been prejudiced by the unscientific attitude of some of these enthusiastic taxonomists Many highly improbable and rash interpretations have been made that did not accord with the known facts Since breeding is usually impossible and our decisions must be based largely on circumstantial evidence, special care should be used to see that our deductions are reasonable The least that can be asked is that these deductions should be based only on careful and painstaking analysis of the evidence Some recent writers have even assumed crossing between parents that do not grow in the locality or even in that part of the country Often general impressions and not an analysis of characters have been sufficient to impress these

enthusiasts The only result is to discredit taxonomy

But equally unfortunate is the attitude that would prohibit the recognition of natural hybridization except in hybrids actually bred genetically The argument that a supposed hybrid, unbred, is merely a matter of personal opinion, and therefore should not be recognized, is invalid, for so are species, genera and families matters of personal opinion In any taxonomic manual the groups there presented represent the author's interpretation of nature and nothing more These groups are based likewise on circumstantial evidence, since he has not seen these species arise in nature, and represent only the conclusions reached from careful study of existing material Why, then, should the taxonomist be adverse to the recognition of hybrids, who is perfectly willing to accept innumerable new species on much less reasonable ground? Taxonomists who do not recognize hybrids are often forced to treat such suspected forms as species They are willing to assume them to be species until some one proves them to be something else, thus placing the burden of proof on the other fellow I, personally, belong to that benighted group of taxonomists, who believe that new species should not be proposed as such until the author can not reach any other conclusion Is it not our duty to science, to workers in other fields and to our fellow taxonomists not to clutter up our subject with endless names and half baked concepts which seem only to confuse and to cause resentment and to pass the buck? The science of taxonomy stands too low now in the estimation of general workers

How, then, should hybrids be named? The recognition of supposed hybrids as hybrids should not necessarily increase the number of names which we all deplore It is my preference to designate ordinarily such a plant by the expression *Quercus bicolor* × *macrocarpa* and not by a new name The only exceptions would be a few hybrids that in horticulture have acquired well known specific names Into this condensed designation "*Quercus bicolor* × *macrocarpa*" we would always read the expression, "A probable hybrid of *Quercus bicolor* and *Q macrocarpa*, according to my interpretation" unless the hybrid had been actually demonstrated by breeding or synthesis But so do we also read into the designation "*Q macrocarpa* Michx" as a species, the statement, "A species, *Q macrocarpa* in the sense of Michaux as interpreted by me" I can not help but see at least a practical difference between the causal more or less evanescent and temporary hybrid and the fundamental established species reaching back perhaps to the glacial epoch or beyond The six fundamental species in the Amelanchier study did not seem in the same category with the hybrids, which, when eliminated, revealed them I prefer to restrict the binomial to these older fundamental units for clearness and also on sentimental grounds

In conclusion it may be asked again what relation then this experience with hybrids in the wild bears to the problem of the origin of species As already mentioned, Lotsy was of the belief that hybridity is very likely the sole cause of the origin of new forms Most biologists, I believe, are not ready to take a stand so extreme but many students of genetics feel that the stable hybrids produced in their experiments represent at least one way by which new species may arise While I would not really question this last statement, the point interesting to me is the almost[3] total lack of support for this view in our experience with the wild hybrids As pointed out, the mass of hybrids in the cases under observation seem wholly casual and in no way to affect the fundamental species which presumably have existed almost unchanged since the glacial period or before It is still possible that these fundamental species came about by hybridity, and that others will also, if sufficient geological time is allowed It would seem however, that the factors noted by the geneticist ought to produce stable forms much sooner than that, even at the longest Still another question, of course, is whether hybridity, which combines the genes of two parents, could produce new characters often enough and of sufficient magnitude to account for the great morphological diversity in plants It is clear, I think that we have not yet solved the problem of the origin of species

The observations and view points expressed in this paper are of course those of one person only, and are presented for what they may be worth However, the angle from which they are presented is not quite the conventional one, and this may be an excuse for afflicting you with them

OBITUARY

ROLAND BURRAGE DIXON

ROLAND BURRAGE DIXON, the senior member of the division of anthropology of Harvard University, died on December 19, 1934 He was the greatest ethnographer whom this country has produced Dixon was born at Worcester, Massachusetts, on November 6, 1875 He took his A B degree at Harvard in 1897 and his Ph D in anthropology in 1900 From the year of his first degree until his death he was continuously

[3] A few cases Huskins (*Genetics*, 12 531, 1931) claims a hybrid origin for *Spartina Townsendii* and Muntzing (*Hereditas*, 14 153, 1930) describes a hybrid in his cultures indistinguishable from *Galeopsis Tetrahit* L both morphologically and in chromosome number—a synthetic *G Tetrahit* Should be further studied

in the service of Harvard University, passing through the various academic grades until he was made full professor of anthropology in 1915 In 1904 he became librarian of the Peabody Museum, in 1908 secretary and in 1912 curator of ethnology At the time of his death he held all these positions

In the earlier years of his professional career, Dixon did extensive field work in anthropology He carried on archeological excavations in Ohio, made ethnological researches among the Indians of British Columbia and Alaska, and spent no less than six seasons of work among the California Indians His subsequent travel and investigation took him to New Zealand, Tasmania, Australia, Fiji and various parts of Asia Nevertheless, Professor Dixon was primarily a student of anthropological literature rather than a field worker He acquired a reading knowledge of numerous foreign languages, which, with his indefatigable industry, enabled him to master existing knowledge of the anthropology of four great continental areas North and South America, Oceania and Asia He classified and digested this prodigious mass of information, put it in card catalogues, and made it the basis of ethnographic lecture courses which were a model of organization and were exhaustive yet stimulating From no other anthropologist in the world could students acquire a similar mastery of anthropological fact Dixon carried an incredible store of this knowledge in his head and could produce instantaneously a detailed and sometimes complete bibliography of any subject within his chosen areas He even succeeded in keeping up to date with the literature of his subject, and, so far as possible, read all of it

In the Peabody Museum library Dixon established a catalogue system whereby books and articles in anthropological periodicals were classified not only by author but also by subject and by area His unflagging energy in pushing forward this formidable task has made the anthropological library of the Peabody Museum the most easily utilizable and the best organized for research of any collection in the world

Dixon's particular anthropological interest was in material culture and its diffusion He wrote many articles on this subject—all notable because of his scholarship and his refusal to be lured from the path of scientific truth by romantic theories His larger works, apart from technical monographs, include a book on the mythology of Oceania, a volume entitled "The Building of Cultures" and his widely discussed "Racial History of Mankind" The last named was an adventurous foray into the field of physical anthropology, whereby the peoples of the world were classified according to the tripartite categories of three cranial indices as combined in individuals This work was based upon a complete study of existing anthropometric material, and was a pioneer effort to establish the principle that racial classification should be based upon individual combinations rather than upon isolated group means In spite of the vulnerability of Dixon's method in several of its processes, he succeeded in establishing a considerable number of important new points concerning human distribution and migration Many of these have been confirmed subsequently by independent investigations of other scholars employing more elaborate methods than his widely condemned "short cut" Dixon was accustomed to refer to this book jocosely as "my crime," but, in the opinion of the present writer (who disagrees profoundly with many of Dixon's results and with most of his methods), 'The Racial History of Mankind' is the most provocative and brilliant book of his anthropological generation It will be perused when many safe and sane anthropological works have been forgotten

Dixon was a solitary bachelor who lived contentedly in a beautiful country home intentionally selected for its remoteness from Cambridge Three times a week he emerged from his seclusion to empty upon his students his capacious vials of knowledge Upon graduate students, engaged in research, he lavished his time and his inexhaustible supply of knowledge As a director and critic of research Dixon was superb In examinations he was formidably exacting, unsympathetic, but just He commanded the fear admiration and respect of his students, and the complete confidence of his colleagues He labored incessantly and effectively to develop at Harvard a well rounded anthropological curriculum based upon sound and conservative scholarship and thorough factual knowledge

Professor Dixon was encrusted with an almost impenetrable reserve, topped with a high gloss of genial courtesy Almost no one had access to the arcana of his personality He was, underneath, a sensitive and kindly man, who led his life according to his own private rules and measured up to his own lofty ideals of conduct and performance Throughout a protracted and wasting illness, he fought indomitably and stubbornly to continue in the discharge of his duties, never admitting to his colleagues (if indeed to himself) the inevitability of his defeat He fully merited the Horatian encomium, "iustum et tenacem propositi virum"

E A HOOTON

RECENT DEATHS

DR DAVID WHITE, senior geologist in the U S Geological Survey and recipient of the Wolcott award from the National Academy of Sciences, died on February 7 at the age of seventy two years

ROBERT R ROWLEY, instructor in science at the Louisiana high school in Louisiana, Mo, and formerly paleontologist with the Missouri Geological Survey, died on January 26 at the age of eighty one years

DR ROGER H DENNETT professor in children's diseases at the New York Post Graduate Medical School and director of the pediatrics department of the Post Graduate Hospital died on February 3 at the age of fifty eight years

FREDERICK O WILLHOFFT formerly professor of mechanical engineering at Columbia University, died on February 6 at the age of fifty eight years

HARRY DE BERKELEY PARSONS, professor emeritus of practical engineering at the Rensselaer Polytechnic Institute, died on January 26 He was seventy three years of age

DR EDMUND B PIPER professor of obstetrics at the University of Pennsylvania Medical School and Graduate School of Medicine, died on January 14 He was in his fifty fourth year

SCIENTIFIC EVENTS

ACQUISITIONS OF THE BRITISH NATURAL HISTORY MUSEUM

THE London *Times* reports that among recent acquisitions of the Natural History Museum, South Kensington, is an important collection of 300 birds obtained by A W Vincent in the southeastern district of the Belgian Congo This area has been very little investigated from the ornithological point of view and the accession includes many forms hitherto unrepresented or very poorly represented in the national collection

A series of skulls of the larger Indian carnivores has been presented by Lieutenant Colonel J H Carlisle, and a collection of game trophies from Northern India and Upper Burma by Colonel C E Nichol Miss A E Thomson has given a very rare flying squirrel from Borneo

A valuable addition to the entomological department's collection of *Hemiptera* consists of 17 specimens of *Termitaphidae* presented by Dr J G Myers, of the Imperial College of Tropical Agriculture, Trinidad These rare and little known insects are found only in the nests of white ants in America and the Old World, but the nature of the association is not known Superficially they suggest in appearance diminutive woodlice or scale insects

A purchase of particular interest is a collection of 500 beetles from Tibet Central Asia, Western China and the Altai Mountains, the majority of which are paratypes of species hitherto unrepresented in the department The Public Schools Exploration Society has presented the whole of the entomological collections made during their recent expedition to New foundland

Geological acquisitions include 100 specimens of primitive fish like Ostracoderms, obtained by Wickham King, chiefly from the old red sandstone of Worcestershire, and a fine series collected by Dr E I White, and H A Toombs from Herefordshire, comprising many forms new to science

As a bequest from the late T B Clarke-Thornhill, the mineralogical department has acquired a valuable collection of gemstones, the 90 cut stones, many of them of large size, include 16 fine colored diamonds, parti colored corundum, tourmaline, opal, alexandrite, etc and there are uncut specimens of opal and moon stone and large masses of Kaurigum from New Zealand

The first meteorite to be recorded from Rhodesia, a stone weighing 481 pounds and 11 ounces, which fell last March in the Mangwendi native reserve, 40 miles east of Salisbury, has been presented by the government of Southern Rhodesia

A NUTRITIONAL STUDY OF BELGIAN UNEMPLOYED

ACCORDING to the *British Medical Journal*, an investigation into the living conditions and budgets of insured unemployed in Brussels was carried out in 1932, and the sociological results have already been published Bigwood and Roost now record the nutritional data under the title L Alimentation Rationnelle The facts were obtained from a month's study (January to February) of nineteen families, chosen at random from the lists of unemployed, which comprised ninety three persons Quantities of foodstuffs bought or given were entered in notebooks The analyses of foodstuffs used for computation were chiefly those of Van de Weyer for Belgian produce, with special analyses where necessary Foodstuffs as consumed probably did not vary more than from −3 to +3 per cent from analytical tables Refuse ranged from 7 5 to 14 per cent of total foodstuffs as bought (average 11 per cent), high percentages being obtained chiefly where the amount of potatoes was large Plate waste was calculated as 1 per cent, intestinal waste as 4 per cent, protein and carbohydrate were calculated to yield four calories per gram, fat nine calories

Complete tables are given for each family for gross and net calories, grams of animal and vegetable protein, fat and carbohydrate The percentage amount

of the total gross weight supplied by the various food groups averaged as follows meat 9, cereals, etc, 55, vegetables 6, fruit 2, fats 3, eggs 1, milk 18, cheese 0, various 6 Family coefficients according to different scales are compared, and that adopted takes the woman as unit and allows her 2,600 calories net, the unemployed man being allowed 2,400, or 0 90, and children scaled down according to age to 0 25 for a child under 1 year The authors reckon that the League of Nations scale of calorie requirement is slightly below that of the Belgian people, as shown by Slosse's investigation into 1 065 working men in 1910

The net calories of the nineteen families varied from – 33 to +30 per cent on the Bigwood Roost scale five families being more than 10 per cent below and therefore certainly receiving insufficient food Protein averaged 81 5 grams per unit, with a range of 55 grams to 105 grams, of which the animal protein averaged 40 per cent (range 27 to 52 per cent) For each gram of protein the average intake of fat was 1 1 grams and of carbohydrate 4 6 grams The minerals per unit were Phosphorus, 1 44 grams calcium, 0 74 gram, iron, 0 015 gram calcium phosphorus ratio, 1 1 95 calcium protein ratio, 1 118 Of the vitamins the B complex was probably sufficient, A or D approximately half of standard requirements, C rather more than half, after allowing for loss in cooking It must be borne in mind that the number of families studied is too small to allow of general conclusions being drawn This study rather suffers from lack of sequence in arrangement and of clarity in the graphs There are nearly a hundred tables, many of which need not have been included, while the addition of more tables summarizing the figures would be of great advantage

PROPOSED STATE FORESTS IN MASSACHUSETTS

A TENTATIVE plan has been prepared by Commissioner Samuel A York of the Massachusetts State Department of Conservation, for an orderly establishment of state forests and parks making use of idle land which at present is of little if any value to either the owners or the communities Mr York, according to the *Boston Evening Transcript,* explained to representatives of the Governor's Committee on the Needs and Uses of Open Spaces that the plan shows in a general way where the land is available for purchase by the state, at a cost of about $5 per acre, which is all the state can pay under the present law, and if the plan is carried out there will be public reservations for recreational purposes within fifteen miles of every large center of population Charles Sumner Bird, Jr, chairman of the committee, presided over the conference

The program would be to buy 30,000 acres a year for ten years, and to acquire for the public six ocean beaches within five years Salisbury Beach has already been acquired, and is now under the management of the conservation department

Commissioner York gave six specific reasons for the plan They are to reforest the waste land in the state, to provide healthful outdoor recreation for the public, to provide worth while work that is non competitive with private industry, to bring increased revenue from tourists, to stabilize rural employment and to preserve and increase the annual $200 000 000 recreation industry of Massachusetts

Each of the areas is to be at least 5 000 acres in extent and is to be developed for recreation wild life and forestry The land needed can be bought for $5 an acre and for a time at least the development will be made by the use of relief funds Relief funds can be used that way to better advantage than if passed out as a dole If the plan were followed creating about twenty six areas in the state the total acreage would be in the vicinity of 740 000 acres inclusive of what the state already owns as in many instances the new purchases would be to enlarge present state forests

As to the cost of the project Mr York explained that much of it would be self-supporting because the policy will be followed of charging for the special services given The public will have free access to parks forests and water fronts, but there will be cabins fireplaces supplied with wood and other facilities for which it will be deemed proper to charge the users a fee And after some years the forest growths will have developed to the point that lumber may be cut and sold

COMMITTEE ON UNEMPLOYMENT AND RELIEF FOR CHEMISTS AND CHEMICAL ENGINEERS

THE Committee on Unemployment and Relief for Chemists and Chemical Engineers, of which A Cressy Morrison is chairman of the finance committee, has sent out the following appeal

Your committee has periodically brought to your attention its efforts to alleviate distress in the profession

During the last three years more than 1 400 qualified chemists and chemical engineers approached the committee for help More than 600 were placed on permanent or temporary jobs Financial assistance was secured for 167 families in desperate need

Nearly 1 000 chemists and chemical engineers have to date contributed a total sum of about $35,000—or an average of $1 00 per month per contributor Our present

funds will soon be exhausted With this inadequate sum, your committee was able to carry on because of the strictest economy, free office space and furniture, voluntary services, and help from government welfare organizations Due to these agencies a large number of very serious cases were placed on temporary relief projects Thanks to all our contributors no case of hunger or inadequate clothing has left our doors without immediate relief and encouragement

With the approaching winter and continued unemployment additional funds must be secured to help 150 whose resources are exhausted The reserves of an additional number of your brother chemists are nearly depleted, and a total of 426 on the committee's active files need jobs very badly The committee, therefore, earnestly asks your serious consideration of this problem and urges your immediate support

Our records show that you have not contributed to the committee so far but we hope that your present circumstances, as one still employed, will enable you to do your part to help those of your professional associates in need

Your cooperation in reporting jobs to the committee's office will be deeply appreciated If you know of any one unemployed ask him to register Bring the committee's efforts to the attention of your coworkers

Checks should be made payable to Robert T Baldwin, treasurer, and should be sent to 300 Madison Avenue, Room 1004, New York City

ANTHROPOLOGISTS AND THE FEDERAL INDIAN PROGRAM

ANTHROPOLOGISTS from all parts of the United States, at their meeting at Pittsburgh, Pennsylvania, December 29, pledged assistance to Commissioner Collier in the work of rehabilitating Indian communities and developing an Indian program directly related to the life and needs of Indian people

Commissioner Collier's address on the new Indian program came at the conclusion of the three day sessions of Section H of the American Association for the Advancement of Science In his address, Commissioner Collier emphasized the land acquisition policy, developments under the Indian reorganization act, and especially the participation of Indians in the new plans A vigorous discussion followed the commissioner's presentation, in which enthusiastic approval was manifested in regard to many of the efforts that are being put forth to aid Indians in achieving economic, social and cultural opportunities

Saturday evening was given over to a special Indian Service conference in which an invited group of anthropologists discussed with Commissioner Collier and members of the Indian Service staff such questions as (1) In what way can we most effectively utilize contributions of anthropology in the work of organizing Indian communities under the Indian Reorganization Act? (2) What types of training shall we set up for both Indians and whites already in the service and for those who may come in later? (3) What shall be the form of continued coperation between the Indian Service and the anthropologists? Secretary Wallace of the U S Department of Agriculture was the first speaker at this evening conference and presented vigorously and sympathetically his views of the economic and cultural needs and possibilities of the Indians

Members of the conference suggested a census of anthropologists as a means of putting at the disposal of the Indian Service anthropological workers acquainted with specific areas There was also general agreement as to the need for assigning a consulting anthropologist to the staff of the Indian Office, whose duty it would be to make necessary contacts with anthropological groups throughout the United States Regional conferences of anthropologists and others were also recommended

In a memorandum presented to the anthropologists in advance of the meeting as a basis for discussion, certain of the projects involving anthropology already under way were presented, including the kind of constitutions for Indian communities and the provisions made so far for Indian Service workers trained in anthropology and related fields

Among the anthropologists who accepted the invitation to be present were Dr Fay Cooper Cole, University of Chicago, Dr Radcliffe Brown, University of Chicago, Professor E Sapir, Yale University, Dr Duncan Strong, Bureau of American Ethnology, Father John M Cooper, of Catholic University, secretary of the American Anthropological Association, Professor A E Jenks, University of Minnesota, Professor Ralph Linton, University of Wisconsin, Dr George Herzog, Institute of Human Relations, Yale University, Rev Berard Haile, Gallup, New Mexico, Professor Robert Redfield, University of Chicago, Dr Margaret Mead, Museum of Natural History, New York City, Dr Herbert J Spinden, Brooklyn Museum, Dr Alexander Lesser, Columbia University, Professor Leslie A White, University of Michigan, Mrs Elsie Clews Parsons, Harrison, New York, Dr Melville J Herskovits, Northwestern University, Professor Leslie Spier, Yale University, Dr Diamond Jenness, National Museum of Canada

In addition to Commissioner Collier, the following represented the Indian Service and Interior Department at the meeting A C Cooley, director of extension, Felix Cohen, of the solicitor's office, Miss Mary McGair, assistant to the commissioner, Samuel M Dodd, budget officer of the Indian Service, F H Dailker, junior assistant to the commissioner, Miss Elinor D Gregg, supervisor of nurses, Miss Sally Lucas Jean, administrative coordinator in the Navajo Area and supervisor of health education, Miss Edna

Groves, supervisor of home economics, Miss Rose K Brandt, supervisor of elementary education, Miss Mary Stewart, assistant director of education Mrs Elna Smith, of the division of subsistence homesteads Miss Evelyn Pierce, of the education division, Mrs Margaret Welpley, of the Indian organization unit, and Albert Sandoval, of Lukachukai, Arizona assistant on the Navajo language project

SCIENTIFIC NOTES AND NEWS

DR CHARLES A KRAUS professor of chemistry and director of chemical research at Brown University, has been awarded the Willard Gibbs Medal of the Chicago section of the American Chemical Society for 1935 for his research on the theory of solutions

PROFESSOR CARL G ROSSBY, professor of meteorology and Dr Hurd C Willett, assistant professor of meteorology at the Massachusetts Institute of Technology on January 30 received the Sylvanus Albert Reed award of the Institute of the Aeronautical Sciences in New York for their contributions to weather forecasting It was largely as a result of their work that the polar front or air mass analysis method recently was adopted by the U S Weather Bureau Dr Joseph S Ames president of The Johns Hopkins University and chairman of the National Advisory Committee for Aeronautics, was made an honorary fellow of the institute

THE Stevens Triennial Prize was awarded in 1934 by the College of Physicians and Surgeons of Columbia University to Dr Robert F Loeb and Dr Harold A Abramson jointly The award to Dr Abramson was made on the basis of his research on the electrochemical reactions of blood cells and is of interest because of his recent summary of the electrochemical properties of surfaces in liquids

AT a recent meeting of the American Society of Civil Engineers the Norman Medal was presented to Leon S Moisseiff consulting engineer of New York City, for his paper on "The George Washington Bridge—Design of the Towers" The J James R Croes Medal was awarded to Dr H M Westergaard, professor of theoretical and applied mechanics at the University of Illinois for his work on "Water Pressure on Dams during Earthquakes" The Thomas Fitch Rowland Prize was awarded to Miles I Killmer for a paper on "Fulton Street, East River, Tunnels" A paper by F Warden Bowman on the steel superstructure of the George Washington Bridge won the James Laurie Prize J C Evans, terminal engineer of the Port of New York, received the Arthur M Wellington Prize Mr Evans's paper dealt with the approaches and highway connections to the George Washington Bridge The Collingwood Prize for juniors was given to G H Hickox and G O Wessenauer, for a paper on the "Application of Duration Curves to Hydro Electric Studies"

AT the dinner of the American Society of Plant Physiologists in Pittsburgh Dr Burton E Livingston, president of the society was presented with a check by his former students at the Johns Hopkins University, on the occasion of his completing twenty five years of service at this institution and in recognition of his services to plant physiology The presentation was made by Dr John W Shive, professor of plant physiology at Rutgers University who received his doctor's degree from the Johns Hopkins University in 1915

DR LEONA BAUMGARTNER of Yale University, now of the Children's Clinic of the New York Hospital, was awarded the John Lovett Morse Prize for her research work upon "Age and Antibody Production" The prize is given annually by the New England Pediatric Society for the outstanding investigation of the year

DR EDNA HARDE YOUNG, American bacteriologist connected with the Pasteur Institute, has been awarded the Guy Amerongen Prize for cancer research for a paper submitted to the French League against Cancer on the thesis that chemically preserved foods aid the growth of cancer cells

IGNATZ MOSCICKI president of Poland and well known for his work in chemistry, was awarded the degree of "doktora honoris causa" at the University of Fribourg in recognition of his thirty years of research in electrochemical research

HARVARD UNIVERSITY has announced the following retirements and appointments Dr George H Parker, professor of zoology, Dr Milton J Rosenau, professor of medicine and hygiene, and Albert Sauveur, professor of metallurgy and metallography have retired Dr Weld Arnold instructor in geological survey and field astronomy, has been appointed assistant director of the Institute of Geographical Exploration for one year, Edwin Raisz has been made curator of maps in the Institute of Geography, and Edmund B Delabarre, Jr has been made assistant in psychology

DR KNIGHT DUNLAP, professor of psychology in the Johns Hopkins University, has accepted appointment as visiting professor at the University of California at Los Angeles for the spring semester

IT is reported in *Industrial and Engineering Chemistry* that Dr Irvin Lavine, professor of chemical

engineering at the University of North Dakota, has been appointed by the National Resources Board of Washington, D. C., to the position of consultant to the North Dakota State Planning Board. He will work with the state board in developing a long range program for the rehabilitation of the state according to objectives laid down by the National Resources Board. The university is extending a leave of absence to him for the period of his appointment. His headquarters will be at the university.

DR. THOMAS A. WILSON, associate professor of chemistry at Union College, has been appointed senior fellow at the Mellon Institute. Dr. J. George Lutz has been made instructor to replace Dr. Wilson.

DR. ALBERT C. FURSTENBERG, professor and head of the department of otolaryngology, has been appointed dean of the Medical School of the University of Michigan.

HUMPHREY GRAY OWEN, associate professor of zoology at the University of Denver, has been made chairman of the division of biological sciences and professor of zoology. He succeeds Dr. Ira Eugene Cutler, who becomes professor emeritus.

THE resignation of Claude R. Kellogg, assistant professor of entomology at the Massachusetts State College, has been announced. Professor Kellogg left on February 1 for China, where he will resume the post of professor of entomology and beekeeping at the Fukien Christian University, which he held from 1916 to 1931.

E. F. ARMSTRONG, British industrial chemist, has been elected chairman of the British Standards Institution.

DR. WALTER B. CANNON, George Higginson professor of physiology at the Harvard Medical School, will leave early in March for China, where he will serve as visiting professor of physiology at the Peiping Union Medical College from April 15 to June 1. After a sojourn in Japan he will cross Siberia and attend the International Physiological Congress in Leningrad and Moscow in August.

J. FRANCIS MACBRIDE, assistant curator of taxonomy in the department of botany of the Field Museum, who has been in charge of the joint botanical project of the Rockefeller Foundation and the Field Museum of Natural History since it was inaugurated about five years ago, sailed for Europe on January 30 to continue the project. Mr. Macbride has been in this country for a visit during the past several months, his first interruption of the work since its inception. The project has for its purpose the making of photographic negatives of type specimens of plants preserved in European herbaria, prints of which, through the Field Museum, are made available to all botanists.

DR. HELLMUT DE TERRA, research associate at the Peabody Museum, Yale University, and chief of the Yale University North India Expedition, sailed on February 2 for India to take charge of excavations in the Himalayan foothills. The expedition will seek further traces of prehistoric man to match with the fossil ape unearthed in Northern India last year. The expedition, sponsored by Yale University, the Carnegie Institution of Washington, the American Philosophical Society, the Geological Survey of India and the Cenozoic Research Laboratory of Peking, China, will have an international personnel. Père Teilhard de Chardin, acting director of the Cenozoic Laboratory; T. T. Patterson, a geologist and archeologist of Cambridge University, and V. N. Ayengar, paleontologist of the Survey of India, are members of the party.

A SERIES of lectures has been inaugurated at the School of Medicine and Dentistry of the University of Rochester to be known as the Eastman memorial lectures in memory of George Eastman. The last lecture was given on November 14 by Dr. Eugene F. DuBois on "The Surface Area of the Body and the Radiation of Heat." On February 5 Dr. Peyton Rous lectured on "Viruses and Tumors."

DR. W. F. G. SWANN, director of the Bartol Research Foundation, lectured at the first meeting of the Lancaster, Pennsylvania, Branch of the American Association for the Advancement of Science on February 13. His subject was "Cosmic Rays."

PROFESSOR ALBERT EINSTEIN was the principal speaker at a dinner given at the Young Men's and Young Women's Hebrew Association in Philadelphia on February 6, as the opening of a campaign to raise $25,000 for the support of the Bicur Cholim Hospital in Jerusalem.

DR. ARTHUR L. DAY, director of the geophysical laboratory of the Carnegie Institution, delivered an address before the Washington Academy of Sciences on January 17. The title of his address was "Public Safety in Earthquake Regions."

THE annual Alpha Omega Alpha lecture of the Jefferson Medical College was given on January 18 by Professor William K. Gregory, of the American Museum of Natural History, on "The Origin, Rise and Decline of *Homo sapiens*."

A SERIES of lectures on our astronomical relations was given in January at Harvard University by Dr. Harlan T. Stetson.

DR RALPH H MAJOR, professor of medicine at the University of Kansas School of Medicine, gave the annual Scripps lectures at the Scripps Metabolic Clinic at La Jolla on November 11, 12 and 13

DR GEORGE GAMOW, visiting professor at George Washington University and research worker in atomic nuclei at the Academy of Science of Leningrad and at the University of Copenhagen, delivered two lectures at the University of Pennsylvania on January 31 A talk on 'Modern Alchemy" was given by Dr Gamow in the afternoon and in the evening he lectured on "Elementary Particles in Physics"

DR H D CROCKFORD associate professor of physical chemistry at the University of North Carolina, has received a grant of money from the U S Naval Research Laboratory of the Navy Department in Washington, to direct research on the thermodynamics of the lead sulfuric acid storage cell

DR G LOMBARD KELLY vice dean of the University of Georgia School of Medicine, announces a gift of $18,000 from Mrs John W Herbert of New York and Augusta for the furnishing and equipment of the new wing of the University Hospital as a memorial to her husband, the late John W Herbert, and to two of their children, Mrs Gertrude Herbert Dunn and John Oliver Herbert

THE board of regents of the University of Wisconsin has accepted a grant of $57,500 from the Rockefeller Foundation to continue research on hormones Funds for the research formerly came from the National Research Council out of funds provided by the Rockefeller Foundation The funds permit Dr F L Hisaw, professor of zoology, Dr I J Cole, professor of genetics, and Dr E L Sevringhaus, associate professor of medicine to continue research on hormones or internal secretion glands which it is thought, control the growth and actions of the human body

A GRANT has been awarded by the committee of scientific research of the American Medical Association to Dr W Antopol, Dr A Schifrin and Dr L Tuchman, to aid in the continuation of experimental work on acetyl choline, especially in its relation to carbohydrate metabolism, which is being carried out in the chemical laboratories of the Mt Sinai Hospital

A COLLECTION of fifteen thousand specimens of wood was bequeathed to the Franklin Institute Museum by the late Henry Howson, of Philadelphia Each piece is numbered with a steel die and bears the common as well as the botanical name

THE National Committee for Great Britain and Ireland of the International Society for Microbiology has arranged to organize a congress in London in 1936, and an executive committee with Professor J C G Ledingham as president, Dr R St John Brooks as secretary and Dr J T Duncan as treasurer, has been appointed to undertake the work of organization The scientific business of the congress will be conducted in seven sections, which will meet daily during the meeting The preliminary selection of programs for these sections will be entrusted to sectional sub committees, which will report to the executive committee Each sectional sub committee will consist of local or London members, together with a recorder and secretary and of corresponding members at home and abroad Sections will be as follows Section 1, bacteria in their morphological, cultural and physiological aspects section 2 viruses virus diseases experimental tumor research and tissue culture, section 3 bacteria and fungi in relation to disease in man animals and plants section 4 economic bacteriology soil, dairy research and industrial microbiology, section 5, medical veterinary and agricultural zoology and parasitology section 6 serology and immunochemistry and section 7 microbiological chemistry

THE annual meeting of the Association of British Zoologists was held by invitation of the Zoological Society in the society s rooms in Regent s Park on January 5 Professor W A F Balfour Browne presided On this occasion the greater part of the time of the meeting was given to a discussion of the present outlook and aims of zoologists In this discussion Professor D M S Watson Jodrell professor of zoology and comparative anatomy at the University College, London Dr J Gray fellow of King's College, Cambridge Dr E S Russell director of the fisheries laboratory of the Ministry of Agriculture and Fisheries Professor E W Macbride professor of zoology, Imperial College of Science and several other speakers took part

UNDER the terms of the will of the late Virginia Purdy Bacon of New York the Smithsonian Institution some years since was bequeathed the sum of $50 000 to establish a traveling scholarship as a memorial to her husband, Walter Rathbone Bacon, for the study of the fauna of countries other than the United States The amount available is the interest on the capital invested which is about $3 000 a year, the incumbent to hold the scholarship not less than two years Application for this scholarship, addressed to the secretary of the Smithsonian Institution, should be submitted not later than March 15 The application should contain a detailed plan for the proposed study, including a statement as to the faunal problems involved, the reasons why it should be undertaken, the benefits that are expected to accrue, the length of the time considered necessary for

the carrying out of the project, the estimated cost, and the scientific and physical qualifications of the applicant to undertake the project The scholarship will be awarded for a term of two years If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance accompanied by a statement as to the necessity for such extension All collections, photographs records and equipment become the property of the institution The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship

Dr L O Howard formerly chief entomologist in charge of the Bureau of Entomology, U S Department of Agriculture writes Government officials of Denmark paid last autumn a very good and well deserved compliment to the work done in the United States in a certain branch of science They invited Dr Adam G Boving who for twenty two years has been working in the U S National Museum and in the Bureau of Entomology of the Department of Agriculture to cross the Atlantic and to give two short courses of lectures in Denmark One of these courses, given at the Royal Museum of Zoology, of the University of Copenhagen, related to the classification of the larvae of the Coleoptera This is a subject that in the last century was studied by the famous Danish workers, Schiodte and Meinert Boving worked with Meinert and, fortunately for us, fate brought him to the United States and to Washington, a generation ago These lectures were well attended by Danish students and workers and by some men from adjoining countries The book by Boving and Craighead published in 1931, entitled 'Illustrated Synopsis of Larval Forms of Coleoptera' and which has been termed 'epoch making' by certain Europeans, incited this course The second course was delivered before the Royal Veterinary and Agricultural College and aroused much interest The agricultural journals and the daily press paid much attention to these lectures They related to applied entomology in the United States and especially described our organization and methods of work Both courses were given in September"

In Science for January 4 on page 24 the address for Dr Gustav Zechel should have been University of Illinois instead of University of Chicago

DISCUSSION

FILM-STRIP COPIES OF SCIENTIFIC PUBLICATIONS

Attention was called some months ago[1] to the efforts being made to reorganize the production and distribution of scientific publications Special emphasis was laid on the need of making published results of research more easily accessible to those who use them It was pointed out that the apparatus and materials required for making film strip copies of printed pages exist at present and all that is needed is to assemble them and systematically organize the service A plan of such an organization was suggested and a preliminary estimate given of the cost of the equipment required

At the time the articles referred to above were written the most highly developed machine for photographing pages of books upon moving picture film, of which I had learned was one of German manufacture for which the quoted price in marks, corresponded to about $1 000

Since then through the courtesy of Dr Robert C Binkley, chairman of the Joint Committee on Materials for Research, I have had the privilege of reading the advance sheets of chapters IX and X of his revised Manual of Methods of Reproducing Research Materials' These chapters give a comprehensive critical survey of the factors involved in applying film copying processes to the reproduction of printed or other documents The contributions of a large number of workers are reviewed and it is apparent that greater progress has been made than is generally realized Some 12 film copying cameras are described and their relative merits discussed Of these, the camera invented and built by Mr Lloyd B Kennedy, of Warren, Ohio, is considered to be the most ingenious so far developed

Of the several cameras at present on the market, the most widely used is the Leica This camera, however, is designed particularly for the use of individuals who wish to make their own copies of documents Its limited film capacity restricts the usefulness of this camera for the large scale production under which a highly organized library copying service would be called upon to operate

On November 5 last Mr Watson Davis, of Science Service, invited to a luncheon at the Cosmos Club of Washington about 15 persons known by him to be interested in the subject of film copying of documents Among those present was Dr R H Draeger, of the Medical Department of the U S Navy Dr Draeger

[1] Science, 80 70–72 July 20, 1934, pages 184–5, August 24 1934 See also address on the Berthelot Centenary, Science 67 497–99, May 18 1928

told of a camera he had built and exhibited film roll copies of books made with it He was led to build his camera by the desire to provide himself with a conveniently transportable film library of scientific publications, for consultation and study while on shipboard or at distant naval posts The camera was completed shortly after he was detailed for a special course of study at the Naval Medical School of Washington While here, the director of the school recognized the utility of the camera for copying rare volumes needed to complete files upon naval hygiene being assembled at the school Upon his recommendation Dr Draeger was provided with facilities for constructing a second and more highly perfected camera, which is expected to be completed shortly

As a result of this information communicated at the luncheon, Miss Claribel R Barnett librarian of the Department of Agriculture, who was also present, has arranged at my suggestion for Dr Draeger to install his camera in her library and make experiments upon copying articles in bound volumes of journals, the loan of which in large numbers is requested by out of town governmental and private research institutions This experimental service has been in operation for over two months and the most varied lot of articles have been copied and sent out

The experiment has conclusively shown that this first stage of a film copying service has been satisfactorily achieved The only other improvements will be in the direction of increasing the automatic character of the apparatus The next step is the designing and manufacture of film strip magnifiers and projectors which will permit one to comfortably read the printed matter photographed on the film

The many film projectors at present on the market have been designed for other purposes and can not be conveniently used for reading film strips without more or less modification In general, they are equipped with holders for film rolls and not short strips Furthermore, the lens focus is usually too long to permit the screen to be placed conveniently near the projector This latter disadvantage can in some cases be overcome by projecting into a box provided with a mirror which reflects the image upon a ground glass

In view of the need of reading equipment especially designed for film strip copies of printed pages, attention has been turned first to constructing a simple magnifier This consists of a short cylinder, to one end of which is fixed a holder to receive the film, beyond which is a ground glass, and to the other a lens capable of being focused to sharp definition of the image

The film strip is inserted, the apparatus is held towards a source of light, the focus adjusted and the brightly illuminated text, which is magnified about 10 times, read without difficulty A film strip magnifier of this kind, provided with a satisfactory lens, a handle and a screen to shade the eye not used, has been constructed at a cost which would permit it to be sold for not more than five dollars

Experiments with such a magnifier have shown that it can also be used for projecting the film copy upon an improvised screen or a reflecting mirror and ground glass mounted in a box All that is required is an efficient source of light This may conveniently be composed of a lamp, condenser lenses and a reflector mounted in a small metal box A clamp bracket permits the light source and film magnifier to be held in line and directed towards any improvised screen or into a reading box provided with a mirror and ground glass Of the three elements composing the apparatus, film strips may be read directly using the magnifier alone or by projection on an improvised screen with the aid of the magnifier and light source or by projection on a ground glass by a combination of the three elements As mentioned above the film strip magnifier with a lens suitable for reading the printed matter directly should cost not more than five dollars Provided with a better lens needed for projecting to a larger scale, the price would probably be within $10 The other two elements of the apparatus can no doubt be furnished for another $10

In the previous communications upon the organization of a film strip documentation service it was suggested that the film strips should be mounted in windows in filing cards and sent out in this form The object of this was to facilitate filing and permit the title and reference to be typewritten on the card and thus the subject matter identified without resorting to magnification or projection of the film copy The high cost of equipping projectors with holding devices for cards as large as would be necessary makes this plan impractical It is now suggested that the film strips be filed in envelopes with the necessary indications written on the outside For reading, the film strips could then be removed and inserted in the ordinary sized slots provided on magnifiers and projectors

In order to facilitate the identification of the subject matter of a given film strip it is contemplated that the title page of the volume in which appears the article copied shall be photographed in the first frame of the strip, together with the abbreviation of the journal title, volume, page and year, copied from a legend sufficiently large to be read on the film strip with the naked eye Thus the film copy will be so perfectly identified that the possibility of its being misplaced from its proper envelope need not be a cause of concern

The film copying service would at first consist simply of photographing the pages of articles in journals and sending the negative film strip to those desiring them The cost would be very low Acetate

film sells for \$20 per 1,000 feet, and since two pages are photographed upon each 1½ inches of film there would be 16 pages per foot. Allowing for the title page, identification reference and a short blank space at each end, the film for a 10 page article would cost about 2 cents. The developing and labor would probably not amount to more than 8 cents per 10 page article, hence it is likely that the service could be rendered by a library, without loss, at 10 cents per article of 10 pages or less and 5 cents for each additional 10 pages. This, however, is only a preliminary estimate and may be subject to revision on the basis of experience gained during an experimental period of operation.

When one considers the complex and expensive organization required for keeping track of borrowed books, the wear and tear to which they are subjected, and the messenger or other service required to deliver them, the saving effected by reducing the number which would leave the library would certainly be an important item. It is even possible that film copying service rendered free might be a saving over the present system of lending library books. It is therefore not unreasonable to expect that even at the low price mentioned, the adoption of film copying by libraries would lead to a considerable economy of operation.

With this end in view and also in consideration of the great service that film copies may be expected to render research workers, Miss Barnett has arranged to have made, at the prices mentioned above, with the equipment of Dr. Draeger, film strip copies of articles contained in publications on file in the library of the Department of Agriculture.

Those desiring to avail themselves of this service should send their orders to the "Biblio Film Service," care of Library, U. S. Department of Agriculture, Washington. It is expected that within a short time film strip magnifying and projecting apparatus, such as described above, will be available.

ATHERTON SEIDELL

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ORIGIN OF PETROLEUM

THE notes on this subject by J. M. Macfarlane and E. Berl recently published in SCIENCE are worthy of some comment. Macfarlane appears to favor the old theory of the decomposition of fish oil, or lime soaps of fish oil, by heat. Berl believes there is evidence that the source material of both coal and oil was "carbohydrates and carbohydrate humic acids."

The writer has pointed out in two recent papers[1] that the older theories of petroleum origin were proposed almost entirely without consideration of the chemical character of petroleum and with little reference to or knowledge of the conditions of its geological occurrence. It was also pointed out that there is abundant factual evidence, of both chemical and geological nature, that petroleum has had a low temperature history, of the order of 100° F. There is also abundant evidence against the early, but still widely prevalent, idea that petroleum is nevertheless the result of heat decomposition of fatty oils or other organic material, these decompositions being assumed to take place at low temperatures by virtue of the great periods of time available, in the case of the older strata, for such change. The evidence is much too abundant to summarize adequately in this brief note.

Berl evidently accepts the evidence of low temperature history. It is a pity that theories of "distillation" and heat decomposition, set up years ago on the simple experiments of Warren and Storer (1867) and of Engler, which do much violence to the many chemical and geological facts that we now know, should continue to clutter up our scientific literature. Surely we owe it to youth, seeking to learn, to clear some of our scientific debris.

The chemical history of petroleum is still bristling with unsolved questions, but how to produce petroleum by cooking fish is not one of them.

BENJAMIN T. BROOKS

NEW YORK, N. Y.

ARE FISHES THE PRINCIPAL SOURCE OF PETROLEUM?

DR. MACFARLANE'S recent communication in SCIENCE[1] calls to mind his theory that fishes are the principal source of material from which natural petroleum has been derived.[2] Even admitting that petroleum may have been derived from fish oil in the rocks by natural processes, he has failed to present convincing evidence of fish remains in sufficient quantity to account for the enormous quantities of petroleum in some formations, having attempted to account for the large quantities in other formations by assuming, without proof, migration from far distant sources, and ignored all other as likely sources. In his interesting book he assumed, for example, that fish remains are very abundant in the Green River oil shales. As I have elsewhere stated, such remains are confined almost entirely to a thin series of strata in a very small area of that thick, wide spread formation.[3] Even in the limited region where the beautiful fish skeletons are

[1] *Bull. Am. Ass'n Petr. Geol.*, 15: 611, 1931; *Jour. Inst. Petr. Technol.*, 20: 177, 1934.

[1] SCIENCE, November 23, 1934.

[2] Macfarlane, "Fishes the Source of Petroleum," The Macmillan Company, 1923.

[3] Henderson, *Proc. California Acad. Sci.*, 4th series, Vol. XV, pp. 269–278, 1926.

found they are not very abundant, and at most localities and horizons they are so scarce as to be wholly negligible. If the fish bones and teeth were destroyed by organic acids, that would have left the scales intact, as actually happened in the Mowry formation. Dr. Macfarlane perhaps also overestimated the abundance of fish remains in the latter formation. True, scattered scales are quite numerous in portions of the formation, but a few fishes would account for a great many of the scattered scales. The Pierre formation is yielding petroleum in quantity at many localities, yet fish bones, teeth and scales are very scarce throughout the formation at all the numerous localities I have examined, and there are no extensive fish beds from which one may safely assume that the oil has migrated. Many such examples may be enumerated, while places where fish remains are abundant in the neighborhood of oil fields have not been found over great areas occupied intermittently by oil fields. On the other hand, some of the oil bearing formations contain vast quantities of remains of mollusks, diatoms, foraminifers and other organisms that may have stored in the rocks enormous quantities of carbonaceous material, which may be a source of petroleum. In addition, forms of algae and protozoa without durable parts that would be preserved in recognizable condition in the rocks, some of which represent groups that produce numerous generations per annum, may have deposited carbonaceous material equalling or exceeding the bulk of all other organisms. The protoplasm of all these organisms contain the elements entering into the composition of petroleum. I see no *a priori* reason why any or all of them may not have contributed toward the petroleum.

It is impossible to duplicate experimentally all the deep seated natural conditions within the thick geological formations, such as heat, pressure, chemical associates and more particularly the time factor. Failure to produce petroleum experimentally from any organisms would not prove conclusively that it could not happen or has not happened under natural conditions during a very long lapse of time. Success in such experiments possibly would not conclusively demonstrate that the same thing has happened in nature. If petroleum is of organic origin, as is rather generally believed, experimentation and discussion, in order to command complete respect, must take into consideration all forms of animal and plant life, and especially the microscopic forms so abundant and almost universally distributed in both fresh and marine waters, all composed chiefly of the elements that enter into the composition of petroleum, each individual of many of the species containing a minute globule of oil.

Junius Henderson

University of Colorado

SCIENTIFIC BOOKS

PHYSICAL THOUGHT

The Development of Physical Thought. By Leonard Loeb and Arthur S. Adams. John Wiley and Sons, New York.

According to the preface, this book is the outcome of a course of lectures prepared and given at the University of California by the senior author. The notes of these lectures were used and revised by the junior author and are published as a joint production.

There is wide recognition of the difficulty of the graduate student and the younger physicist in coordinating his rather patchy knowledge and in getting a proper perspective of his science. The historical chronological development of a science is perhaps the natural one. Ideas grow. Even the mistakes and false starts are of value. The student who studies the development of ideas, including the errors, is sure to obtain a knowledge of the growth of his science which will be useful in his later specialization and teaching.

A comprehensive knowledge of the growth of physical ideas is also particularly valuable to the teacher who is presenting the science to the beginning student as a cultural subject.

This book should be a help both to the student and to the teacher of physics, and the reviewer recommends it to their attention. The first chapter, which is headed "Historical," gives an interesting account of the thought and activities of the early Greeks and Romans and the limitations of their scientific methods. The importance of Aristotle and his great influence on thought through the Middle Ages is discussed and stressed. Also the authors point out the great influence of economic and political conditions on the growth of science.

The succeeding chapters take up successively the development of mechanics and dynamics, heat and the structure of matter, electricity and magnetism, light, and finally the electrical structure of matter and the new physics. The space given to each of these topics varies considerably, perhaps according to the special interest of the authors. The chapter on light might have been more extensive and clearer, particularly in the treatment of refraction and dispersion. The last chapter on the new physics is much the longest. This is not so desirable, as the young physicist is apt to know this field fairly well. A philosophical grasp of the growth of classical physics is more important for him and also more difficult.

Just because this is a book that may be largely used by the student of physics it is the duty of the reviewer to point out a few things that are not clear or that may be in error. The treatment of certain topics of the relativity theory is not clear and might be improved. The attempted explanation of the bending of a ray of light on passing the sun is rather confusing, and the student would have difficulty in grasping its meaning. The reviewer makes this statement with some hesitation, as he recognizes the difficulty of presenting relativity ideas in simple terms.

There appears sometimes to be confusion in the ideas of our younger physicists as to the development of certain concepts and results of the relativity theory. This confusion is somewhat evident in this text. At least there are some statements that are not clear. One might cite as a case in point the discussion of the dependence of mass on velocity. On page 164 the authors say "Other theories based on the electrodynamics of Maxwell gave a change of mass with velocity when the velocity approached that of light but the equations derived were not substantiated by the experiments of Bucherer." This is not a proper statement of fact. The Lorentz electron equation,

$$m = \frac{m}{\sqrt{1-\beta^2}} \quad \text{where } \beta = \frac{v}{c}$$

was derived on the classical theory assuming a fixed ether. (See theory of electrons by Lorentz, Columbia University Lectures, 1906.) Historically the matter is of some interest. Independently of the relativity theory not only was the above equation derived by Lorentz, but Bucherer himself derived a classical expression for the variation of mass, namely

$$m = \frac{m_0}{(1-\beta^2)^{1/3}}$$

These were both deformable electrons postulated on a fixed ether. The experiments of Bucherer were undertaken to find out whether either of these expressions (or the earlier one of Abraham) was the correct one. His results indicated that the Lorentz equation represented the facts better than his own or Abraham's. One infers from the text, although the statement is not specifically made, that these experiments are a proof of the special relativity theory. However, the experiments of Bucherer could not and did not distinguish between the hypotheses assumed by Lorentz and Einstein. The writer of this review is a proponent of the relativity theory, but he would like to point out that *logically* the experiments of Bucherer are not a *unique* proof of the special relativity theory. They only prove the validity of the equation

$$m = \frac{m_0}{\sqrt{1-\beta^2}}$$

Another unclear passage is the discussion of the residual advance of the perihelion of Mercury. The authors in discussing the above equation say "For most earthly motions the relation is such that the mass does not vary appreciably with the velocity, but when v begins to be of same order of magnitude as c, it is seen $(1 - v^2/c^2)$ becomes less than 1 and the mass will increase. A case in point is the variation of the velocity of Mercury in its orbit, which becomes sufficiently great that the mass of the planet computed on the Newtonian basis is no longer able to account for its motion, hence the discrepancy in the calculation of the motion of the perihelion of Mercury mentioned above." This is not very clear, but it seems to mean that the advance of the perihelion of Mercury arises from a change of mass with velocity. This, however, is not the case.

In an elliptical orbit according to the Newtonian law there is a relation

$$F/m = a$$

the acceleration for each point of the orbit. As the velocity changes in the orbit the mass will change also to a value m′. But according to the general relativity theory gravitational force and mass are proportional. The force F will change also to a value F′ in such way that

$$F'/m' = a$$

the same acceleration as before. The ratio of the new force to the new mass will be the same as in Newtonian motion. The residual advance of the perihelion of Mercury arises from a modification of the space due to the sun's gravitational potential. The case is quite otherwise with the motion of an electron in an elliptical orbit about a central charge. Here the mass changes with the velocity, but the force does not. The advance of the perihelion in the case of the electron is described by the *special* relativity theory (or Lorentz equally well). The advance in the case of the planet Mercury is described by the *general* relativity theory.

The reviewer found the chapter headed "Historical" quite interesting. It should stimulate the student to further reading in the history of science.

It is desirable to point out one or two errors of date for future correction. Carthage was destroyed at the end of the Third Punic War 146 B.C. and not 201 B.C., as stated in the text. Also the authors state that 'the fakir and simpleton' Cagliostro was put to death by the inquisition in 1750. Cagliostro was born in 1743 and died in prison in Rome in 1795. He cannot properly be called a "simpleton." He was rather a very clever and unscrupulous charlatan.

BERGEN DAVIS

COLUMBIA UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A GLASS ASSEMBLY FOR SEITZ BACTERIOLOGICAL FILTERS

BACTERIOLOGICAL filters are so made that the filtered liquid comes in contact with metal surfaces which usually contain copper or some other heavy metal On one occasion a drop of water suspended from the stem of a well washed and freshly sterilized Berkefeld filter contained enough copper to have a distinct blue color and give a flame test for copper In view of the known static action of very small amounts of heavy metals for bacteria even in protein media, it seems possible that contamination by copper or other metals may sometimes be sufficient to cause erratic variation in the growth of bacteria in synthetic media [1] Such

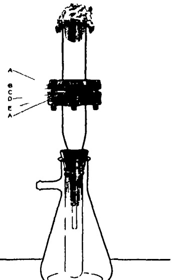

FIG 1 A Iron flanges B Filter paper C Seitz filter disc D Aluminum or platinum support E Asbestos interface gasket

variation was in fact observed in this type of medium when the usual filters were used in sterilization, but not when a glass filter assembly was used

In order to escape such an obvious possibility of contamination by heavy metals a modified Seitz filter has been devised in which the liquid comes in contact with no metal surfaces other than aluminum or platinum In addition to being easily constructed and allowing full vision of the material being filtered, this device has the advantage of being much less expensive than the usual filter of this type

The heavy pyrex glass piping which has recently become available in a variety of sizes can be used to construct such a filter For the filtration of 50 ml or less, two straight 4 in lengths of 1 in flanged piping with the metal flanges bolts and asbestos interface gaskets to fit may be used One of the straight lengths is cut in two and to each half is sealed an appropriate funnel tube If suction alone is required only one of these need be used The flanges and gaskets are then put in place and between them is inserted a Seitz filter pad This is supported on a sheet of aluminum foil which may be 5/1000 in thick or more, patterned after the gasket and perforated by about 50 pin holes The bolts and nuts are adjusted loosely and after the usual preparation for filtration the apparatus is sterilized in the autoclave The bolts are tightened with a small wrench before the apparatus is used

The filter pad requires support since atmospheric pressure is sufficient to break through the wet pad The aluminum support here described has given satisfactory service over a period of six months There is no visible corrosion in the central part and but slight corrosion at the exposed edges Platinum gauze has been used but no great advantage over aluminum has been discovered The apparatus assembled for filtration by suction only is shown in Fig 1

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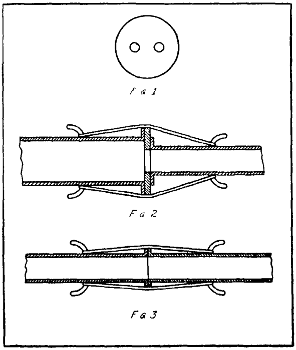
[1] E O Jordan and I S Falk, "Newer Knowledge of Bacteriology and Immunology," University of Chicago Press, 1928, p 284

A SIMPLE GLASS CONNECTION

AN easily made glass to glass connection which will serve satisfactorily in many glass apparatuses where



only small pressures or vacua are developed is shown in Plate 1

Pieces of tubing, mouths of flasks, etc, are simply flared and given a flat lip, and then this lip is grounded in the usual manner by emery on a flat glass surface The customary small glass arms for anchorage of rubber bands for holding pieces together can be easily fused to the main element

The writer has built 'T's,' 'L's,' and straight lengths of tubing of varying lengths which are all surprisingly interchangeable Figs 1 and 2 give a simple method for reducing the diameter of a tube—i e, by the insertion of a ground glass disk with a hole in it The ground glass disk idea is also satisfactory where it is desired to have two tubes connect with one vessel or another tube Fig 3 shows a straight connection involving the same size tubing

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HARTFORD CONN

SPECIAL ARTICLES

A SYNTHETIC PEPTIDE AS SUBSTRATE FOR TRYPTIC PROTEINASE

LITTLE is known regarding the mechanism and the specificity of those enzymes which split true proteins—the proteinases This is due to the fact that until recently it was not possible to obtain a proteinase substrate of known structure

By means of the carbobenzoxy method[1] a peptide like substrate for tryptic proteinase was synthesized It is a derivative of the tripeptide glycyl glutamyl glycine (I) The amino group at one end of the molecule was blocked with the carbobenzoxy group and the glycine carboxyl on the other end was esterified with ethyl alcohol (II) Thus the only free reactive group was the γ carboxyl of the glutamic acid

$$NH_2\cdot CH_2\cdot CO—NH\cdot \underset{}{CH}[(CH_2)_2\cdot COOH]\cdot CO—NH\cdot CH_2\cdot COOH$$

I

$$C_6H_5\cdot CH_2\cdot O\cdot CO\cdot NH\cdot CH_2\cdot CO—NH\cdot CH[(CH_2)_2\cdot COOH]\cdot CO—NH\cdot CH_2\cdot COOC_2H_5$$

II

$$C_6H_5\cdot CH_2\cdot O\cdot CO\cdot NH\cdot CH_2\cdot COOH$$

III

$$NH_2\cdot CH[(CH_2)_2\cdot COOH]\cdot CO—NH\cdot CH_2\cdot COOC_2H_5$$

IV

Substance II was split quite rapidly by pancreatin Merck as well as by a preparation of crystalline trypsin (tryptic proteinase) kindly placed at our disposal by Dr John H Northrop The products of the splitting were carbobenzoxy glycine (III) and glutamyl glycine ester (IV) The latter product is rapidly transformed to a diketopiperazine under the conditions of the experiment

This experiment shows that tryptic proteinase does not require for its action linkages of unknown nature, but is able to split ordinary peptide linkages if the rest of the molecule fulfils certain structural requirements In II one of these requirements is the presence of the free γ carboxyl, which combines with the tryptic proteinase and thus enables it to split the peptide

It is probable that the other amino dicarboxylic and diamino carboxylic constituents of the proteins play a role similar to that of glutamic acid in combining with proteinases by means of their extra acid or basic groups From the work of Gurin and Clarke[2] it is to be expected that the ε amino group of lysine in a protein combines with pepsin By means of the carbobenzoxy method we are preparing peptides of lysine and aspartic acid and shall report on their behavior towards proteinases in the near future The theoretical significance of these results as well as the interesting experiments of Matsui,[3] Ishiyama[4] and Shibata[5] on the splitting of diketopiperazines will be discussed in a future publication

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[1] M Bergmann, SCIENCE, 79 439, 1934

[2] S Gurin and H T Clarke *Jour Biol Chem*, 107 395 1934

[3] J Matsui, *Jour Biochem*, 17 163, 253, 1933

[4] T Ishiyama, *Jour Biochem*, 17 285, 1933

[5] K Shibata, *Acta Phytochimica*, 8 173, 1934

THE ELECTRICAL RESPONSE OF THE VESTIBULAR NERVE DURING ADEQUATE STIMULATION

A STRIKING characteristic of the vestibular nystagmus which is produced in virtually all vertebrate species by the angular retardation incident to the termination of a prolonged period of uniform bodily rotation (also by the acceleration incident to the onset of such a period of rotation) is that this response ordinarily persists for a considerable time—often 20 or 30 seconds—after the cessation of its

objective stimulus In order to account for the discrepancy between the duration of this response and the duration of its stimulus, two general theories have been advanced The *peripheral* theory holds that the post stimulus persistence of vestibular nystagmus is dependent upon a continuation of the excitatory process (inertial movements of the endolymph displacement of the cupula, or the like) which is initiated in the vestibular receptors by the objective stimulus The *central* theory on the other hand, holds that the post stimulus persistence of this response is dependent upon the action of a neural mechanism located within the brain, which, once properly excited by a stimulus, however brief, continues to transmit effective impulses to the muscles involved in nystagmus until either this after discharge" mechanism becomes self damped (perhaps through a gradual lengthening of the refractory phase of the constituent neurons) or until its activity is checked by the occurrence of an opposing stimulus

In the hope of obtaining possibly more definitive evidence than has previously been advanced in support of either of these two rival hypotheses the writer has undertaken a systematic comparison of the duration of objective stimulation of the vestibular receptors and the duration of the action currents thereby produced in the vestibular nerve By means of a vacuum tube amplifying apparatus developed by Dr E G Wever and Dr C W Bray, of Princeton University, for use in their investigation of the electrical phenomena of the auditory nerve, it has been found possible to make the passage of impulses along the vestibular nerve audible in a telephone receiver The results thus far obtained from the study of the common painted terrapin (*Chrysemys picta*) indicate that, at least in this type of subject (selected because of particular accessibility of the vestibular nerve), the action currents probably never last for more than a fraction of a second after the cessation of objective stimulation When the terrapin is accelerated on a manually operated turntable, there is audible in the receiver a distinct burst of discharge, and when the animal is retarded there is audible another similar burst of discharges, even though the maximum angular velocity attained be quite moderate During prolonged rotation weaker discharges may be heard more or less continuously, due presumably to the more or less constant stimulation of the vestibular receptors through slight unavoidable variations in the speed of rotation However, at the end of rotation, objective stimulation definitely ceases, and in no case has the passage of impulses been heard for more than approximately half a second after the subject has come to rest

It is conceivable, of course, that effective impulses may continue to pass over the vestibular nerve (due to a continuation of the excitatory receptor process) for many seconds after the end of objective stimulation, without necessarily being detectable by the technique just described However if further investigation with oscillographic recording and a more accurately controllable method of stimulation confirms the results thus far obtained it will be reasonably certain that the post stimulus persistence of vestibular nystagmus is due, not to a concomitant persistence of receptor activity, but rather to sustained after discharges from a neural mechanism located within the brain

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THE SPECIAL REACTIVITY OF PEPTIDES

IT is one purpose of the present note to point out that, whereas current theory seems to assume that most of the obvious transformations of amino acids occur when these are present as such some of these reactions may really take place much more readily as transformations of peptides

For some time the writer has been interpreting the decomposition[1] of cysteine and cystine derivatives by alkalies as a reaction in which preliminary enolization allowed expulsion of the sulfur (with whatever might be attached to it) as a negative group Theory and recorded fact seemed to agree as to the modifications of the amino and carboxy groups necessary to produce greatly increased reactivity Peptides (and analogous compounds) were conspicuously more reactive than simple amino acids though less reactive (for reasons which will be explained elsewhere) than cyclic derivatives such as diketopiperazines and hydantoins

From the beginning it was assumed[1 2] that this type of reaction would be reversible It has now been found possible[3] to add p tolylmercaptan to α acetyl aminoacrylic acid to form S p tolyl N acetylcysteine, and this is now leading to a new cystine synthesis which will perhaps have a definite relation to the natural synthesis of cystine The important point in the present connection is, however, that it is decidedly easier to add[3] mercaptans to benzoyl dehydro phenylalanyl glycine ester, which may be considered as a model of a dehydro tripeptide The addition as well as the elimination of sulfur derivatives thus occurs according to the principles already advanced That is, it occurs more readily in a peptide which is at least a tripeptide, and in which the active portion of the molecule is not in a terminal position

[1] B H Nicolet, *Jour Am Chem Soc* 53 3066, 1931
[2] B H. Nicolet, *Jour Biol Chem*, 95 389, 1932
[3] Unpublished results

Thus two reactions, the decomposition and the formation of cysteine and cystine derivatives, occur more readily in the case of peptides To these may be added a longer known third reaction fulfilling the same conditions—the racemization of peptides[4, 5] by alkali A further extension of the principle will now be considered

Is 'Oxidative Deamination' a β Oxidation?

Oxidative deamination[6] of amino acids to α keto acids under biological conditions is an accepted concept So is, to a considerable degree, the intermediate formation of a "dehydro" amino acid, which is, however, formulated as RCH C(NH$_2$)CO$_2$H (A) or as RCH$_2$C(NH)CO$_2$H (B), according to the tastes of the particular author concerned The two types are tautomers Type B is almost surely involved in the hydrolysis, but whether A or B is originally formed in the oxidation is a matter of much interest

Some theoretical aspects of a reaction leading to the initial formation of Type A will now be discussed In the first place, such a reaction could conveniently be regarded as a special case of β oxidation, and such a view point allows the drawing of certain conclusions which, it seems to the writer, may eventually allow a decision to be reached

It is clear that the 'oxidation" of hydrogen, even when it involves merely the transfer to an acceptor other than oxygen, involves the approach of the hydrogen atoms concerned to a more positive character But the hydrogen of least positive character, and therefore that most subject to oxidative attack, is located on the β carbon atom, due to the effect of the carboxyl group This effect, while in the case of a free amino acid relatively feeble, is still very real, and it should favor the formation of a dehydrogenation product of Type A

But two types of modification of the amino acid structure should favor such β activation quite strongly These are just those modifications which have been reported as affecting so strikingly the reactivity of the sulfur carbon bond in cystine derivatives, and excellent examples would be, peptide formation on both the amino and carboxy groups In other words, *if* oxidative deamination is essentially a β oxidation, and occurs through a derivative of Type A, it can be predicted that it will occur most readily in substances which have at least the complexity of tripeptides, and that in these the middle member of the tripeptide chain will be the most susceptible to dehydrogenation

So far as the writer knows, no clear cut distinction on this basis has been made as yet, either theoretically or experimentally A variety of "model" experiments in deamination have recently been reported in which charcoal, with or without air, or substances of quinoid type, have been used to induce the reaction These experiments, which can not here be cited in detail, show glycine to be attacked with exceptional ease This is certainly not β oxidation, but neither is it clear that the type of deamination used in the body is here represented On the other hand, Krebs[7] has managed to demonstrate oxidative deamination of the usually assumed type most convincingly, since he has also isolated derivatives of the expected α keto acids, but the kidney tissue with which he induced the reaction contained such a complex of proteolytic enzymes that it has not yet been possible to decide whether or not peptides are attacked more rapidly than the simple amino acids It is perhaps a modification of his procedure which will settle the question

The main idea of this portion of the present discussion is definitely this In so far as oxidative deamination under more or less biological conditions attacks peptides more rapidly than simple amino acids, and the intermediate members of peptide chains rather than the terminal members, in just that measure it will appear probable that the first stage of oxidative deamination is a β oxidation, leading to an initial product of Type A

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[4] H D Dakin, *Jour Biol Chem*, 13 357, 1912, H D Dakin and H W Dudley, *ibid* 15 263, 1913

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SCIENCE

VOL. 81 FRIDAY, FEBRUARY 22, 1935 No. 2095

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

CERTAIN ASPECTS OF GEOLOGIC CLASSIFICATIONS AND CORRELATIONS[1]

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GENERAL CONCEPTS

OUR knowledge of the history of the earth has been developed gradually by fitting together the histories of small areas studied in detail. As the early geologists gradually became familiar with the rock formations of their own districts, they began to classify the strata in groups. Comparison of individual findings with those of geologists in other areas was particularly stimulating and led to more searching and critical study; correlations between different regions were attempted, and historical geology began to overspread political boundaries. In the course of time the full succession of rock systems came to be recognized and the broader outlines of the geologic history of Europe and North America became established.

[1] Address of the vice-president and chairman of the section on Geology and Geography, American Association for the Advancement of Science, Pittsburgh, December 31, 1934.

Rather notable it was that the rock systems built up from the stratigraphic sequences and fossil peculiarities of Europe were found to be applicable and useful also in North America, though three thousand miles of Atlantic Ocean lay between. Now the same rock systems and corresponding geologic periods do service the world over. Though great variation in local details is manifest, distant regions seem to have enough in common to make possible a general history of the earth in world-terms. Why this is possible, we can now understand.

We know that for long stretches of time the continental land masses have remained relatively free from diastrophic movements of the more declared sort, during which times erosion has lowered the lands and shallow epicontinental seas have spread widely over their reduced surfaces. Part of this spread of the seas has resulted directly from cutting down the lands

and deposition of much of the eroded material in the oceans, thereby displacing an equivalent volume of water and causing a rise of sea level. However modified in detail by local crustal movements, from which the earth is never free, as well as frequent eustatic fluctuating of sea level, the general tendency toward continental inundation at such times is world wide. In these seas have accumulated the successions of sedimentary beds which constitute the marine phases of the rock systems. The sedimentary record developed at such times in such seas has, in general, been most nearly complete; it comprises, as a rule, the best known portions of most rock systems and is most nearly comparable the world over. During these times of extensive transgression of the seas over low lying continents, the climates have been largely oceanic in nature, mild and equable, and shallow water marine life has prospered in an expansional phase. The marine faunas have then been as cosmopolitan as such faunas ever are. Consequently, given sufficient short lived, rapid traveling species, paleontologic correlations of the strata formed at such times are at their best, and these portions of the general earth story have been put together most correctly.

Had the relatively quiescent conditions of one of these periods been sufficiently quiet and persisted sufficiently long, the land masses would have been base leveled and eventually submerged beneath ever spreading seas. But, happily for land life, we find that after a long period of sea transgression, but before complete wearing down of the lands and final submergence was accomplished, a reversal of processes has invariably occurred. Recurring stresses have rejuvenated large portions of the continents and folded certain belts into mountain chains. Like the transgression of the sea, its regression is also far more than a local phenomenon.

We know that the principal belts of mountain building, such as those of the Caledonian, Hercynian, Alpine and Cordilleran orogenies, have been very long, arcuate strips, the last named of which reached fully a third of the way round the globe. Such long, winding belts of earth wrinkling tell of world stresses rather than local stresses, and imply a certain parallelism of major events over large areas. The diastrophic revolutions are thus of more or less cosmopolitan significance.

Very important for our problem, however, is the relation of general continental emergence to the more intensified orogenic earth distortions. It is natural enough to regard both relative uplift of continental areas and the much stronger deformation of particular belts as differently expressed results of the same earth stresses. One phase of this conception is the belief of some geologists that episodes of strong folding are genetically related to sinking of the ocean basins. On this question, however, there is no unanimity of opinion. But, as a rule, we find that general emergent conditions have been an accompaniment of the orogenic revolutions. To the emergences we owe the breaks in the stratigraphic sequence. Furthermore, we recognize that the orogenic revolutions have been characteristically short in duration compared with the times of relative quiescence and extended marine sedimentation. Accepting the generalization that the revolutions are accompanied by general emergences and important interruptions of the marine sedimentary record, they naturally serve as positive beats to mark off the long geologic periods of earth rhythm.

But because of the areal extent of a diastrophic revolution, exactly synchronous earth yielding in different portions of the globe is hardly to be expected. Indeed it would be strange if the resistance of the rocks were overcome at precisely the same time throughout the whole stretch of a major deformation. All the eggs in a nest do not hatch the same day. Although we recognize a general simultaneity, just how nearly synchronous the earth failure has commonly been throughout a belt of deformation is one of the important questions of geologic history, upon which more information is greatly needed. The problem of correlation would be less complex if each diastrophic revolution consisted of but a single pulsation, but instead it commonly consists of several distinct episodes or separate paroxysms of relatively short duration spaced between longer and quieter intervals. The relative intensity of the individual paroxysms may vary from place to place. Viewed in detail the problem of correlation appears very complicated, but viewed in larger units it becomes simpler because in many cases the whole revolution has occupied a span of time much less than that of either the geologic period immediately preceding or that immediately following, and the span of the revolution as a whole has been more or less contemporaneous over the globe.

The consequences of an episode of major deformation are far reaching. Large areas of epicontinental sea bottom become land; in these marine sedimentation ceases, erosion occurs, and an unconformity eventually results. Climates become more diversified as oceanic conditions give place to continental conditions and severe mountain climates develop locally. Glaciation comes on in the more declared cases and extreme aridity may appear in places. Plants and animals are profoundly influenced by the changing environments. This whole combination of related changes has been attendant upon the diastrophism. In recognition of this, two decades ago, appeared the dictum

"Diastrophism is the ultimate basis of classification and correlation"

The full accomplishment of these ramifying developments requires, however, a considerable length of time, and the changes do not progress everywhere at the same rate Such is inevitable in the very nature of the case Consequently, a close correlation of the individual steps in the progress of events over widely separated areas, while correct in many cases, is manifestly incorrect in other cases Variability has characterized many of the links in the chain Although certain changes, or certain steps of advancement, did not take place at the same time in different regions, nevertheless the diastrophic revolution, which inaugurated the changes, is the basic process upon which the rest are dependent So it is that our geologic periods, though originally established primarily on stratigraphic and paleontologic grounds, are for the most part found to be delimited also by episodes of pronounced diastrophism Since much of the globe has been involved to some extent in the diastrophism, our present geologic periods and rock systems are also of wide applicability and have become standard over the whole earth But this does not mean that the future will see no changes in the periods as now outlined, there are not a few infelicities in our present classification, with increasing knowledge and a better understanding of the real significance of a geologic period, it is probable that important improvements will be made Some of them are perhaps already in sight

Pre Cambrian Correlations

The nebular hypothesis of Laplace gave rise to the very simple picture of a hot molten globe which froze over on the surface and thereby gave rise to an original granitic crust which came to be called the primordial Archean and on which were laid down in succession the later sedimentary deposits The Archean thus conceived was very clear cut and definite Now this distinctiveness has largely disappeared, water laid sediments are among our oldest rocks, and where to place the upper limit of the Archean has become a matter of pronounced difference of opinion Sir Charles Lyell's doctrine of uniformitarianism now applies as well to our earliest rock revealed geologic history as to that of any later time, and if we could decipher the rocks beneath the oldest yet studied who can say that the doctrine would not still apply? The beginning of the familiar geologic processes on the globe is beyond our ken A pre Archean rock system is more than a possibility Viewed in this light, the Archean system takes on a different aspect Its lower limit must be passed over, but where shall its upper limit be drawn? This question leads to the principles of pre Cambrian classification and correlation

The great thicknesses of pre Cambrian strata, like those of later ages, are naturally grouped into their larger units on the basis of pronounced unconformities This is a practical procedure because the unconformities make natural divisions Pre Cambrian strata are also classified and correlated on the basis of large batholithic intrusions which cut across certain rock groups but do not penetrate other groups This also is a practical field method of differentiating formations or groups of formations We therefore ask ourselves To what extent are time divisions based on granites merely a matter of practical convenience and to what extent do they have fundamental significance? Is there any relation between strong angular unconformities and batholithic intrusions?

For clearer understanding we turn to later and better known eras of earth evolution The later diastrophic revolutions reveal a common sequence of events First is the well known accumulation of many thousands of feet of sediments in a geosynclinal trough or belt of pronounced sinking Secondly, after a long period of accumulation these weak sediments are compressed during a very much briefer interval of time into a folded mountain system During a late stage of the strong folding process, but before the deformation ceases, large masses of acid magma characteristically intrude the heart of the folded mass The rocks which have participated in the folding are cut across extensively by the invading magma and in places are strongly metamorphosed Thirdly, the processes of erosion now proceed to reduce the mountains to lowlands, if the reduction goes far enough they uncover the intruded plutonic rocks in the core of the folded belt and they may bring the entire region to the condition of a peneplain The first and third stages each occupy more time than the second Subsequently, sedimentary deposits may again be laid upon the site of the former mountain system constituting an entirely new group of rock strata The new rock system is thus separated from the older system, or systems, by a strong angular unconformity representing a long interval of time during which important events took place in the region

In this problem the significant feature of the granite is that its injection occurred at the time of mountain making between the earlier period of sedimentation and the later period of sedimentation It therefore belongs to a part of the time interval represented by the unconformity between the two sedimentary systems and serves in a positive way to mark that interval Consequently a classification on the basis of the granite is essentially the same as a classification based on the unconformity

The practical value of intruded granites in pre-Cambrian correlation lies in the fact that the batholithic masses are now exposed over considerable areas throughout much of the deeply denuded belt of correlative folding. They can thus be used rather generally along the grain of the folded structure in any one given structural province. Such structural provinces we know to be long in the direction of the axial lines of folding, but as a rule they are much more limited in width across the grain of the region. Recognition of their extent and limits is very important in pre-Cambrian correlations.

For a given province such as the southern margin of the Canadian Shield, or at least important portions of it, the granite method of classifying rock systems is theoretically sound. In this particular province the three granites of widely different ages, the Laurentian, Algoman and Killarney, are practically and potentially of great assistance in unraveling and delimiting the pre-Cambrian systems. In actual application, however, a serious drawback arises from the fact that in many places, where exposures are limited, the correct identification of a particular granite is very difficult, though probably not beyond solution by our present field methods. The ultimate outcome at any rate looks hopeful.

But when an attempt is made to correlate, for example, the Archean of the southern border of the Canadian Shield with any group of rocks in the Piedmont area of the Atlantic states, the grounds for correlation by our present field methods are extremely insecure. Two different structural provinces are involved and while, according to our general conception, some relationship in the historical sequence of the two provinces is natural, we do not know the extent of such relationship. One or more of the three great pre-Cambrian diastrophic revolutions with batholithic intrusions may have occurred in the Canadian Shield, while only mild manifestations of quite a different sort affected the Appalachian Piedmont. Conversely, strong pre-Cambrian folding may have occurred in the Piedmont at a time when the Shield was but slightly involved. The so-called Archean of the Appalachian Piedmont therefore may, or may not, correspond to the recognized Archean of Lake Superior.

It has been common practise to designate as Archean the extensive granites of the Bighorn Mountains, those of the Front Range of Colorado and those of various other Rocky Mountain ranges. But, as a matter of fact, can we tell whether the granites which underlie the Cambrian sandstones in the Front Range of the Colorado Rockies are correlative of the Laurentian granite of the Canadian Shield, or of the Algoman granite, or of the Killarney granite, or whether they were intruded at some entirely different time or times? In the same way the Vishnu schists in the bottom of the Grand Canyon in Arizona are called Archean. But, after all, do ordinary field studies give us even the basis for a poor guess that these schists are in reality Archean, in the sense of being pre-Laurentian? These several regions lie far apart and apparently are different structural provinces. Similarly, the correlation of the Archean between continents, together with any attempted separation of the pre-Cambrian into Archeozoic and Proterozoic in distant lands on a time basis, faces like uncertainties. Ordinary geologic methods will help solve these problems, but it may be doubted whether they will solve them satisfactorily.

But there is in sight a method which offers good hopes of giving us the desired correlations. That method apparently our chief hope in long-distance pre-Cambrian correlations, lies in the age determinations of intrusive rocks by measurement of the radioactive disintegration which has taken place within them since they were intruded. Time, measured in years, can be compared directly throughout the extent of the earth's surface. The major intrusions of acidic magma came with the diastrophic revolutions which were critical times of earth history and properly serve to mark off geologic periods. If their ages can be determined with a fair degree of accuracy we are on the road toward a satisfactory classification of the pre-Cambrian and the correlation of its major divisions in different structural provinces and on the different continents in so far as there has been a parallelism of events in the areas considered. Success in discovering the true relations will depend largely upon the accuracy of the time estimates.

How reliable are the radioactive determinations of the ages of intrusive rocks? This question is now being investigated critically by capable chemists and physicists in an effort to iron out the present discrepancies in the results obtained by different lines of attack. Progress seems assured and satisfactory results are apparently to be expected. Professor Lane informs me that in particularly favorable cases, which depend upon minerals high in uranium taken from freshly opened material, the probable error in age determination may be of the order of 5 per cent.

From geologic evidence, the Laurentian, Algoman and Killarney granites appear to be so different in age that radioactive age determinations should distinguish between them. We, therefore, have every reason to expect that identification and correlation on this basis will soon be possible. Such correlation obviously will not stop with the Canadian Shield, but comparisons should be possible with other granites of North America and those of other continents as well. From the granites as time markers, correlations may then be extended with varying degree of certainty to

the associated sedimentary formations. At last we seem to be on the eve of general pre-Cambrian correlations on a basis which invites considerable confidence.

The utility of the method is of course not limited to the pre-Cambrian. Especially useful it should be in bringing the pre-Devonian history of the southern half of Africa into accord with the general history of the rest of the globe. In South Africa the oldest well preserved fossils occur in Devonian strata; there the expression pre-Devonian has somewhat the same connotation as has pre-Cambrian in other continents, yet South Africa displays many important rock systems older than the Devonian, now known only by local names. Their proper placing in the established periods which do service elsewhere is greatly needed.

We may now return to our earlier question. Where shall the upper limit of the Archean be placed? In the several different positions in the rock column where it is now placed by different geologists we see the diversity of current opinion. For the Canadian Shield the choice lies between the Laurentian revolution and the Algoman revolution. Each has its advocates, and partisanship seems to depend primarily upon the portion of the shield with which the individual is most familiar. Geologists studying the Lake Superior region have been impressed with the great difference between the pre-Laurentian basement complex, which can be unscrambled with great difficulty, and the post-Laurentian metamorphosed sediments to which stratigraphic methods of investigation can be more successfully applied. On the other hand, to geologists working in eastern Ontario and Quebec, the Algoman revolution has seemed to have occasioned a greater break in the rock record than the Laurentian revolution. The question therefore becomes: Which revolution is more important in general earth history?

The secular trend in historical geology is from provincial points of view toward increasing cosmopolitanism as ever widening areas of the globe are receiving detailed study. Local peculiarities are to be subordinated to those of more general application. In this spirit, though we may prefer one or the other of these revolutions for the close of the Archeozoic, we may well keep a somewhat open mind awaiting comparisons with other important pre-Cambrian areas as better correlations become possible. In the meantime we have Leith's suggestion that time equivalency in the pre-Cambrian be held in abeyance for the present and that instead the basis for the major divisions be rock types, as rocks of the Archean type and rocks of the Algonkian type. This has its uses. But by definition geology is the history of the earth and its inhabitants, and pre-Cambrian history will not be on a satisfactory basis until a fair degree of time equivalency has been established there as in the later history of the globe. Very close time equivalency, however, must not be expected nor implied by pre-Cambrian correlations. Possibly it may prove most practical to divide the pre-Cambrian only into a succession of rock systems and periods without attempting to group these into eras. In any case the large units are systems and not series as some of them are now so commonly called. The Lower Huronian and the Upper Huronian, for example, however they may be named, are each fully comparable to a typical Paleozoic system, either in duration of time, sedimentary successions or according to diastrophic cycles.

THE KEWEENAWAN PROBLEM

The divergence of opinion in classifying the Keweenawan system of the Lake Superior region serves to illustrate another phase of the general problem of classification and correlation. Here a succession of lava flows totaling many thousands of feet was followed by waning volcanism and the deposition of a great series of subaerial clastic sediments, interbedded at first with flows, but continuing long after the flows ceased and the more pronounced deformative movements which produced the Lake Superior basin had largely come to an end. In Michigan and Wisconsin this thick succession of terrestrial conglomerates, sandstones and shales has long been known as the Upper Keweenawan. In Minnesota the apparent correlative was designated the Red Clastic series by Hall, Meinzer and Fuller in 1911. Both are overlain by the well established marine St. Croixan series of the Upper Cambrian. As recently stated by Trowbridge and Atwater, geologists working from the older rocks upward in the stratigraphic column have included all the Keweenawan below the marine St. Croix series in the pre-Cambrian, whereas those working from the Paleozoic downward in the stratigraphic sequence, finding that the undoubted Upper Cambrian sandstones are not set off from the older clastics beneath by any very pronounced break, have not seen sufficient reason for separating the Upper Keweenawan from the Cambrian. Many of the latter have favored placing the Upper Keweenawan in the Cambrian and some have carried the idea further to include the entire Keweenawan in the Paleozoic.

In 1926 Stauffer was fortunate enough to obtain in well cuttings from the upper part of the Red Clastic series of Minnesota a few brachiopods and trilobites which resemble those found in the Middle Cambrian of Montana and Wyoming. The shales in which these fossils occur he confidently referred to the Middle Cambrian. Here indeed was an important step forward. An arm of the Middle Cambrian epiconti-

nental sea, though perhaps only of transient duration, reached Minnesota and by its fossil record has served to date the upper beds of the Red Clastic series Previous to the arrival of this sea a long period of non marine deposition is indicated by the main mass of the Red Clastics

The general picture now becomes clearer The interval between the Proterozoic and the Paleozoic was characterized by an emergent North America Late in the Proterozoic (following our present classification) prodigious floods of lava poured into the Lake Superior basin Gradually the lava outwellings slackened and thousands of feet of continental clastic deposits, derived in part from erosion of the lavas, continued to fill the subsiding basin Rejuvenation of the waste supplying areas at the close of the Proterozoic would but increase the supply of detritus and prolong the depositional process No notable break in the continuity of the series need have occurred As the processes were entirely continental in nature and dependent largely upon sufficient relief of the land, changes in sea level far removed from the Lake Superior region had little effect on them Readvancing seas which started the deposition of the marine Lower Cambrian beds in many other parts of the globe need have caused no appreciable changes in these interior lands Subaerial denudation and subaerial deposition would continue on during early Cambrian time, subject in general only to those changes which are inherent in the advance of peneplanation We must recognize that, in such cases, it is entirely natural for provincial continental deposition of a more or less continuous sort to bridge the gaps between periods and even eras Such linking land deposits have been formed at various times in various parts of the globe, producing a particularly troublesome type of classification problem Finally the Middle Cambrian seas reached Minnesota and Later Cambrian seas spread over still more of the Lake Superior region Marine sedimentation succeeded subaerial as the period advanced

Thus a considerable portion of what has been called Keweenawan seems to have been deposited in Cambrian times But the early portion of the great Keweenawan succession is very much older and has suffered moderate diastrophism It is distinctly pre-Cambrian in type, though time classification by types is not necessarily conclusive, since types reveal prevailing conditions with greater certainty than they do specific time Nevertheless, in the case in hand types do appear significant We thus seem to have in this Lake Superior continental succession a lithologic record of the long interval between established Proterozoic and recognized Paleozoic of which, thus far, so little has been known This fact alone adds not a little in interest and importance to further investigation of the various aspects of the problem

The general nature of what has happened in this region is more or less clear, but for the purposes of classification where is the division between the Keweenawan and the Cambrian to be made? That is one of the immediate objectives For the next step, however, present information is inadequate Further directed study is necessary Provisionally the division between the Keweenawan and the Cambrian may perhaps be placed at some break or pronounced change in the sedimentary sequence According to Joseph Adler, some possibilities have already been noted in the Keweenaw Peninsula region Ultimately the division may need to be modified for better accordance with the general diastrophic history of North America just preceding the Cambrian when the nature of the events which took place at that time shall be more fully understood

THE PERMIAN

From the close of the Proterozoic we pass on to the close of the Paleozoic The Permian is peculiarly the period of problems Few times in the well recorded history of the earth have been characterized by such critical happenings as the closing stages of the Paleozoic Diastrophism of the most pronounced sort, glacial climates of surpassing intensity, an extraordinary development of red beds throughout the globe and profound biologic changes combined in climacteric fashion to make this a time of striking events and difficult problems

The Hercynian revolution converted large areas of shallow sea into land and uplifted extensive tracts in various parts of the globe into lofty mountains, which together are thought to have been instrumental in bringing on diversified, continental climates of unsurpassed severity which, in turn, apparently led to extinction of many forms of life and a radical modification of others to meet the altered conditions This chain of consequences was of a far reaching sort, and the full sequence of events occupied a long time The changes were slow in the aggregate, though profound They came to be strongly in evidence in Pennsylvanian time and lasted in milder form into the Triassic The intervening time during which these interrelated events took place is the Permian or Permo Carboniferous It was emphatically a time of transition, from the mid Pennsylvanian to the Triassic, from the Paleozoic to the Mesozoic, from ancient to medieval life

Shall this long time of transition be considered a regular geologic period, and, if so, shall it be placed in the Paleozoic or in the Mesozoic? If not an independent period, shall it be added to the Carboniferous or to the Triassic, or shall it be divided between them?

Questions such as these have been arising in the minds of geologists for some time and have led recently to a symposium before Section C of the British Association at the Bristol meeting on the validity of the Permian as a system, and to another discussion of the same general problem at the Sixteenth International Geological Congress in Washington The diversity of expressed opinion has been very great Some of the elements considered have been The length of time represented the evolutionary changes, distinctiveness of the fauna and flora, general usefulness and practical convenience, adherence to the original definition, redefinition on the basis of marine invertebrates, the break within the Rothliegende, possible fixing of limits according to episodes of the Hercynian revolution, etc Including the Permian in the Carboniferous, it has been thought, would make that system too cumbrous putting the Permian and Triassic together would make that system too unwieldy Some students have favored partition of the present Permian, but most of those who have expressed views have preferred retention of the Permian in some form In general the discussions from the standpoint of the practical stratigrapher have been thorough The broader philosophical aspects of the problem, however, have received rather less consideration

Geologic thought has now progressed to the point where the larger implications of the earth s past record are becoming clearer and more essential in an adequate understanding of the earth drama It is now coming to be generally recognized that the Hercynian revolution in the Pennsylvanian, followed by extraordinary glacial climates and marked aridity in the later Pennsylvanian and Permian, was of great importance in bringing on the change from ancient life to medieval life Obviously the biologic response to these exceptional physical conditions is rightly to be regarded as of prime consequence, but is it, after all, of greater importance than the chain of physical events which caused it? The more distinctive repression of the old order of life and rise of the new apparently started with one of the strong episodes of Hercynian deformation and the adverse climates Inevitably, however, the process of elimination and readjustment extended through a considerable span of time There were also further episodes of deformation with attendant consequences Some forms of life disappeared early, other forms persisted longer, new forms, born of adversity in its varying degrees, came on the scene at different times and in different places

Where to draw the line of division between the Paleozoic and the Mesozoic therefore involves the general question Shall the new era commence with the most pronounced expression of the underlying physical phenomena and the beginning (or an early stage) of the biologic response, or shall it start only when the biologic response has progressed so far that the fauna and flora have become radically different from those which preceded? Shall the chain of transitional events be hooked on to the previous era as its dying phase, or shall it belong to the new era as its inauguration? Or shall it be divided between them? Whichever alternative we work toward, it is essential that we recognize properly the diverse elements involved in a satisfactory solution of the problem

The appearance of new forms of life is generally regarded by paleontologists as of greater significance than the disappearance of lingering forms of old life Viewing the problem in this light, we should naturally be inclined toward moving classification boundaries forward, or earlier in time, rather than in the reverse direction In the present case this is toward the onset of the pronounced changes in physical environment which were seemingly so important in influencing the evolut onary progress among plants and animals If we are correct in tracing the remarkable succession of physical changes of the Permian back to the exceptional display of diastrophism we naturally look to the diastrophism as the primary control

But the problem is not simple The diastrophism during this transitional time was episodic in character, recurring in several separate spasms At the close of the Mississippian period occurred the Culmide disturbance which serves to divide the Carboniferous into Mississippian and Pennsylvanian In Europe this has been termed the Sudetic deformation for, between the Dinantian and Middle Carboniferous, there was strong folding from the Vosges Mountains t the Sudetes The importance of this division of geologic time is becoming increasingly apparent It may be noted in passing that David and Sussmilch believe that the first of the late Paleozoic glaciations of Eastern Australia, which follows the Wallarobba (Culmide) disturbance, took place at about this time

Particularly prominent also was the Asturian phase of the Hercynian revolution, occurring between the Westphalian and Stephanian epochs of Wester Europe, or the Moscovian and Uralian of Fastern Europe At that time arose great mountain chains across much of Central and Southern Europe and apparently South Central Asia as well In this country strong deformation occurred in the Wichita Arbuckle-Ouachita region, in the so called Ancestral Rockies, and probably also in portions of the Appalachian system, approximately correlative with the European deformation

Considerably later, following the Autunian (Lower

Rothliegende) came the Saalian deformative episode, notably in Central Europe the Eastern Alps and the Ural Mountains. Extensive unconformities and important floral changes were associated with this episode. After the Dunkard though we do not know just how soon after, was the main Appalachian revolution in the Eastern United States. This may well have been contemporaneous with the Saalian diastrophism of Europe, but the correlation has not been definitely established.

At the close of the Permian, as now delimited, came the Pfalzian episode of Stille in the Palatinate of Germany and some neighboring areas. This diastrophic manifestation was feebler and more local than the others just mentioned.

(To be concluded)

OBITUARY

JOHN ALEXANDER MATHEWS

JOHN ALEXANDER MATHEWS died suddenly of a heart attack on January 11, 1935, at his home in Scarsdale. At the time of his death he was vice-president and director of research of the Crucible Steel Company of America and a metallurgist of world-wide repute.

For over thirty years he was in the first rank of American steel metallurgists and among his most notable achievements were the use of the electric furnace in the quantity manufacture of high quality steel, the improvement of high speed steel by the addition of vanadium in 1903 (Rex AA) whereby its cutting efficiency was trebled, the development of various vanadium steels, especially spring steels and of oil hardening magnet steels of chrome vanadium and of corrosion and heat resisting steels and the so-called stainless steels.

Born at Washington, Pa., May 20, 1872, he took his B.S. degree at Washington and Jefferson College in 1893 and M.S. in 1896. Coming to Columbia University he obtained his A.M. in chemistry in 1895 and his Ph.D. in 1898. After instructing in the chemical department at Columbia for two years he was given the Barnard fellowship and with it went to the Royal School of Mines, London, in 1900, to study metallography under Sir William Roberts-Austen. It was there I first met him; we were the only two graduate students that year, had adjoining benches and were soon very good friends, for no one could resist his kindly and friendly manner and good fellowship; in fact, all the students in metallurgy used to drift over to his desk to hear about the States. Roberts-Austen thought so highly of him that he strongly recommended Mathews for one of the first Carnegie Scholarships of the British Iron and Steel Institute, which he received. Returning to Columbia in the fall of 1901 with me in tow we worked in Henry Marion Howe's laboratory in the basement of Havemeyer Hall, Mathews on a series of alloy steels which were made for him at the Sanderson Steel Company at Syracuse, myself continuing the work I had begun with Roberts-Austen on the bronzes at the next bench. His report on this work was awarded the first Carnegie Gold Medal by the Iron and Steel Institute. Finishing this work he went to the Sanderson Brothers Steel Company, Syracuse, as metallurgist in 1902 and soon became assistant manager. From there he went in 1908 to the Halcomb Steel Company, Syracuse, of which he was operating manager and in 1913 president and general manager until 1920, when he became president of the Crucible Steel Company of America. Three years of being a president of a steel company was enough for any real scientist and so in 1923 he was promoted to what he considered a really satisfactory job, namely vice-president and director of research.

He served on numerous technical committees, notably that on aircraft engine forgings of the Bureau of Aircraft Production during the war, was for some time chairman of the Iron and Steel Committee of the American Institute of Mining Engineers, and of the Committee on Alloy Steels of the National Research Council and did notable work on various committees of the Society for Testing Materials, etc. He was also a member of the Columbia School of Mines Advisory Committee and for several years gave an annual lecture to the pre-engineering class.

He was a clear, concise writer and published about 100 papers, chiefly on the constitution and properties of alloy steels. His worth was recognized by his associates. He received the Carnegie Gold Medal from the British Iron and Steel Institute in 1902, from Washington and Jefferson the honorary Sc.D. in 1903, the Hunt Gold Medal from the American Institute of Mining and Metallurgical Engineers in 1928, and was an honorary member of the American Society of Steel Treaters (now the American Society of Metals). In 1924 he was appointed the second Henry Marion Howe lecturer of the American Institute of Mining Engineers, succeeding Professor Albert Sauveur of Harvard.

It is so easy to tell what a man has done, to list his honors and publications, but how difficult to put in words what he really was. To those who knew him in public or private life or worked with him on committees or in the works that is not necessary, for his kindly personality and the charm of his company

endeared him to all His friends will miss him, but more lasting will be the loss to those young men who grew up under him, either in the laboratory or in the plant, engaged in research or production, for in him they always had a real friend, who combined those rare qualities of leadership in both the practical and the scientific side of their work, of a patient teacher and a reliable guide It is to such men we can give the title of a kindly gentleman

WILLIAM CAMPBELL

COLUMBIA UNIVERSITY

CHARLES EDWARD MOLDENKE

DR CHARLES EDWARD MOLDENKE, born on October 10, 1860, at Lyck, East Prussia, died at his home in Watchung, N J, on January 18 Dr Moldenke received his B A and M A degrees from Columbia University and his Ph D from the University of Strassburg He was widely known as a student of classical archeology, antiquities and history and was a philologist of the first rank, master of 19 languages including Hebrew, Arabic, Sanskrit, Icelandic Anglo Saxon, Pehlevi, Hieroglyphic, Hieratic Demotic, Coptic, Cuneiform and Persian His fame as an Egyptologist was world wide He was the first to translate the inscriptions on the New York Obelisk in Central Park and was the author of seven books on Egyptian subjects

Having extensively traveled throughout Europe, Asia Minor, northern Africa and many parts of the Americas, his interest soon turned to the wonders of nature Becoming a diligent student of botany, he became an indefatigable collector, not only of antiquities, but also of plant specimens In 1886 he published an important work on the trees of ancient Egypt, bringing together for the first time all available information about the trees cultivated by the ancient Egyptians, including their origin, uses and names In 1911 he traveled and collected in Cuba, Puerto Rico, St Thomas, Jamaica, Panama and Venezuela, and in 1916 and 1927 in New England, northern New York and Pennsylvania In 1929 1930, accompanied by his younger son, he botanized throughout the southeastern states, spending six full months in Florida alone, which he traversed from end to end, paying special attention to the flora of the everglades, subtropical hammocks and the keys Over 23,000 plant specimens were collected on this trip alone In 1932 he made a circular tour of the entire United States, visiting every major phytogeographic province and making excellent and thorough collections of the representative flora of each province In 1933 he botanized through the Middle West, the bad lands of South Dakota and the Black Hills, and in 1934 visited again the rich collecting grounds of Kentucky, Arkansas, Oklahoma, Texas and Louisiana Including the many plants brought back by him from his European, Oriental and African travels, Dr Moldenke collected over 50 000 plant specimens, the majority of which are now deposited in 30 of the leading herbaria of the Old and New World and the remainder now being assembled into sets for distribution by his son, an assistant curator at the New York Botanical Garden

CORRESPONDENT

SCIENTIFIC EVENTS

THE SECOND INTERNATIONAL NEUROLOGICAL CONGRESS

THE second International Neurological Congress will be held in London from July 29 to August 2, under the presidency of Dr Gordon Holmes At the program executive conference held in London in 1933 Sir Charles Sherrington was elected president by the assembled delegates, but since then he has been compelled to resign on grounds of health According to the *British Medical Journal,* the various sessions of the congress will be held in the large hall of University College, Gower Street, W C 1, and in lecture rooms of the college After the official opening on July 29, Professor O Marburg will preside over a discussion on the epilepsies, their etiology, pathogenesis and treatment, and this will be continued in the afternoon under the chairmanship of Professor O Rossi The morning of July 30 will be devoted to a discussion of the physiology and pathology of the cerebro spinal fluid, under the chairmanship of Professor O Foerster, and miscellaneous papers will be read in the afternoon On August 1 Professor H Claude will preside over a discussion of the functions of the frontal lobe, and on the morning of August 2 the hypothalamus and the central representation of the autonomic system will be considered under the chairmanship of Professor H Brouwer The afternoons will be occupied with the reading of miscellaneous papers The number of these afternoon sessions will be determined by the total number of papers offered and accepted, so far as proves practicable, the papers will be grouped systematically under different headings In the evening at eight thirty the triennial Hughlings Jackson memorial lecture, under the auspices of the section of neurology of the Royal Society of Medicine, will be delivered by Professor O Foerster, of Breslau

The program committee is composed of the British

officers of the congress and the above named chairmen of the morning discussions, with Dr. S. A. Kinnier Wilson as its secretary. Abstracts of each paper to be read at the morning sessions must be submitted to one of these chairmen or the program committee not later than March 1, by which time also the completed papers must be in possession of the committee. The abstracts must be written in English, French or German. As regards the afternoon sessions, not more than one paper from any one member of the congress is permitted, but members may take part in any discussion which arises from any paper. All neurologists, neuro-surgeons, psychiatrists and any physicians or surgeons interested in neurology may become active members, the fee being £1 10s. Applications for membership should be addressed to Dr. Kinnier Wilson, 14, Harley Street, W. 1, London, or through one of the national committees. The social events and excursions arranged so far include an official reception on the first evening; receptions by the Royal Colleges of Physicians and Surgeons on the second evening; the official banquet on August 1, at 7:30 P. M.; a reception on August 2 in the evening by the section of neurology of the Royal Society of Medicine, and visits to Oxford, Cambridge, Stratford-on-Avon, Windsor and Goodwood.

THE NEW YORK UNIVERSITY WEATHER STATION

THE establishment of a weather station by the New York University College of Engineering, equipped for both ground and upper air observations, on the University Heights campus, has been announced.

The new station, the first meteorological observatory in uptown New York, will be under the direction of Dr. J. Edmund Woodman, professor of geology and lecturer on aeronautical meteorology and navigation at the Guggenheim school of aeronautics at the university.

Weather reports will be made twice daily both to the U. S. Weather Bureau in the Whitehall Building and to the Airway Weather Bureau station at the Newark airport. The station has been named as one of a dozen 'special' stations reporting directly to the New York office of the Weather Bureau, and as the first cooperative upper air station in the country. The observatory apparatus has been placed on the roof and in the tower of Graduate Hall on the University Heights campus, and will be available as an instructional laboratory for students of meteorology. Graduate Hall, once the residence of the late Chancellor Henry Mitchell MacCracken, is modeled after New England seacoast homes and is surmounted by a glass-enclosed lookout tower, which should be ideal for the weather recording apparatus.

Pilot balloons will be sent aloft in time for observations to be phoned at 8 A. M. and 8 P. M. daily, for observations in the upper air. The balloons, about three feet in diameter, are inflated with carefully measured quantities of hydrogen just before use so as to give them a known ascensional rate of 600 feet per minute. After release the balloons are observed through a theodolite, an instrument resembling a surveyor's transit, and a record is made of the balloon's position each minute it is visible. For night observations the balloon is made visible by attaching to it a small Chinese lantern lighted by a paraffin candle.

Instruments which will be placed on the roof of the new observatory will include a nephoscope for determining the direction, velocity and disintegration of clouds at various levels, an airways anemometer and anemoscope to give instantaneous readings of wind direction and velocity, an anemoscope and anemograph to give a continuous two-day record of wind direction and velocity, maximum and minimum thermometers, sun thermometers, and a rain gauge.

An instrument shelter just constructed will house a thermograph to give a continuous record of temperature, a whirling psychrometer to give relative humidity and rate of evaporation, and a hair hygrometer to give a continuous record of humidity.

Inside the tower of the observatory there will be a mercurial barometer and a microbarograph and a battery of aneroid barometers for determining atmospheric pressures; a battery of accurate Centigrade and Fahrenheit thermometers, anemograph and airways indicators for determining wind velocity and direction, a hygrodeik for determining relative humidity, several sling psychrometers, plotting boards and other weather instruments. The station will have a meteorological library and facilities for research.

GIFT FOR SUPPORT OF DENTAL RESEARCH AT YALE UNIVERSITY

A GRANT of $17,500 has been made by the Carnegie Corporation of New York to Yale University for the support of dental research in the School of Medicine during the coming year, according to an announcement made by President James Rowland Angell. This gift makes possible the continuance of a program launched six years ago to promote the scientific study of the teeth and to stimulate the interest of physicians in the rôle played by the teeth in health and disease.

The dental research project at Yale is unusual in many ways and has been watched with interest from its inception by both the dental and medical professions. It is one of the few organized attempts to enlist medical personnel and resources in the study of dental problems and to provide a full medical train-

ing for a group of men fundamentally interested in the teeth

The program of the school does not call for the development of a training center for dentists The aim is not to supplant dentists by physicians or to replace dental with medical education The purpose in the first place is to increase knowledge of the teeth, their development, and the diseases to which they are subject, and secondly, to establish a closer relationship between dentistry and medicine so that each field can benefit from the other A small group of men are being given the opportunity to become highly skilled in dentistry and medicine in order to conduct research and to establish a link between these two related sciences

The study group consists of members of various departments in the School of Medicine, a dentist who is on the full time teaching staff of the school and a small number of recent graduates of dental schools selected on the basis of skill and scientific interest in the care and study of the teeth Two graduate dentists have been admitted each year to the regular course in medicine In addition to studying medicine they engage in research on dental problems under the supervision of staff members, and assist in providing dental service for patients in the dispensary and hospital

Progress along various research lines has been made by the dental study group Among the benefits of the program, in addition to the results of research, are cited the increasing recognition in the medical school of the importance of the teeth and the growing interest in them as a subject of study, improvement in the care of hospital and dispensary patients because of the consideration given to the condition of the teeth, and the general stimulus given to dental research and education

The interest of a group of New Haven dentists in the project as a whole has been demonstrated by the formation of the Dental Clinic Society which provides over 500 treatments monthly for indigent patients The society has its own professional staff, but is conducted in close cooperation with the dental study group and community social agencies

THE CANCER CLINIC OF THE POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL OF COLUMBIA UNIVERSITY

A LARGE and completely equipped clinic for cancer and skin diseases, which is prepared to give 200,000 treatments a year, was opened recently in the New York Skin and Cancer Unit of the Post Graduate Medical School and Hospital of Columbia University, according to the New York *Herald-Tribune* The new clinic was formed by the affiliation of the Stuyvesant Square Hospital, better known as the New York Skin and Cancer Hospital, with the Post-Graduate School last autumn It combines the out patient services of the departments of dermatology and syphilology of the two hospitals and occupies the entire four-story building which formerly housed both the in and out patient services of Stuyvesant Square Hospital

It is believed that the new clinic will rival the dermatological centers of Europe There will be a staff of eighty physicians and technicians, with administrative offices, social service, pharmacy, x ray and photographic departments, and every facility for the examination of patients and the investigation and modern treatment of disease There are several laboratories with ample facilities for clinical and laboratory research, as well as operating rooms for minor surgery and biopsies and demonstration and lecture rooms

An important possession of the clinic is approximately 1,200 milligrams of radium, valued at $77 908 The radium treatment of disease will continue under the same procedure as before affiliation, the only change being that the treatment of general cancer cases has been taken over by the Post Graduate Hospital, which cares for all hospital patients For this reason the radium, formerly the possession of the Stuyvesant Square Hospital, has been transferred to the department of radiology of the Post Graduate Hospital, so as to be available to all departments of both institutions The clinic is open daily, except Sundays and holidays, with morning and afternoon sessions

Both institutions have carried on considerable research work In the new clinic the field will be covered by research in immunology mycology, histopathology, physics, x ray and radium, biospectrometry, bio chemistry and cancer research In time the new institution should rank with such centers of teaching and research as the St Louis Hospital in Paris, Pautrier's Clinic at the University of Strasbourg, the University of Zurich Clinic in Switzerland and the Breslau Clinic, which was formerly under Jadassohn's direction

Both hospitals were founded in 1882 and each was a pioneer in its respective field, the Stuyvesant Square Hospital being the oldest cancer hospital in America, and the Post Graduate Hospital the first exclusively graduate school of medicine in the world

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will meet in Detroit, Michigan, from April 10 to 13, inclusive

Members who can do so will doubtless wish to continue the practise of arriving one day in advance of the formal sessions in order to devote that day, which

this year falls on Wednesday, April 10, to visiting laboratories, informal social gatherings and discussions

The Hotel Statler will serve as headquarters All scientific sessions, except the demonstrations on Friday afternoon, April 12, will be held in the Masonic Temple The demonstrations will be given in the School of Nursing and Hygiene of the Henry Ford Hospital The Masonic Temple is within walking distance of the Hotel Statler Special bus service will also be provided The program is as follows

On April 10, there will be held meetings of the executive committee of the federation and of the councils of the societies and the annual meeting of the American Institute of Nutrition at the Masonic Temple The laboratories of the following Detroit institutions will hold open house for the federation on Wednesday and during the remainder of the week The Henry Ford Hospital, Grand Boulevard and Hamilton Avenue, The Children's Fund of Michigan, 660 Frederick Street, The Wayne University College of Medicine, 1521 St Antoine Street, Parke Davis and Company, foot of McDougall Avenue, Frederick Stearns and Company, 6533 E Jefferson Avenue

On Thursday, April 11, there will be scientific sessions of the societies in the morning, and in the afternoon scientific and business sessions of the societies will be held

On Friday, April 12, scientific and business sessions of the societies will be held in the morning and joint demonstrations in the School of Nursing and Hygiene of the Henry Ford Hospital will be shown in the afternoon Tea will be served later in the Clara Ford Nurses' Home In the evening the annual dinner of the federation will be in the grand ballroom of the Hotel Statler

On Saturday, April 13, the scientific sessions of the societies will be concluded In the afternoon there will be a joint session of the federation

There will be a special registration and information bureau which will be located on the mezzanine floor of the Hotel Statler

A reduced fare on the "Certificate Plan" of one and one third fares for the round trip to and from Detroit will apply to members and associate members of the Federation of American Societies for Experimental Biology (and their dependent families)

The local committee in charge of arrangements consists of Dr F W Hartman, *chairman*, Dr Icie G Macy, *secretary*, Dr Oliver Kamm, Dr Thomas L Patterson, Dr O M Gruhzit, Dr O H Gaebler, Dr Arthur D Emmett, Dr Arthur W Dox, Dr Daniel A McGinty, Dr Melville Sahyun, Dr Nelles B Laughton Further information about the meeting can be obtained through Dr H A Mattill, *secretary*, The State University of Iowa, Iowa City, Iowa

SCIENTIFIC NOTES AND NEWS

DR LAFAYETTE B MENDEL, Sterling professor of physiological chemistry at Yale University, has been awarded the Conne Medal of the New York Chemists Club for 1934 for his 'outstanding chemical contributions to medicine "

THE 1934 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Henry E Warren, president of the Warren Telechron Company, Ashland, Mass, "for outstanding contributions to the development of electric clocks and means for controlling central station frequencies" The medal will be presented to Mr Warren at the summer meeting of the institute, which will be held at Cornell University from June 24 to 28

DR WILLIAM P MURPHY, of the Harvard Medical School and the Peter Bent Brigham Hospital, has been awarded the Order of the White Rose by the President of Finland with the rating of Commander of the First Rank He was also made a member in December, 1934, of the Kaiserlich Leopold Carolin Deutsche Akademie der Naturforscher

PROFESSOR FRANK D ADAMS, of McGill University, has been elected a foreign member of the Royal Swedish Academy of Science, and an honorary member of the Academia Asiatica of Teheran, Persia

SIR GEORGE SEATON BUCHANAN, senior medical officer of the British Ministry of Health, was presented on January 25 with the Jenner Medal of the Royal Society of Medicine

THE Progress Medal of the Royal Photographic Society of Great Britain has been awarded to Harold Dennis Taylor, in recognition of his inventions, research and publication in optical science, which have resulted in important advances in the construction of photographic lenses and in the development of photography

PROFESSOR A VON EISELSBERG, president of the Medical Society of Vienna, has been nominated doctor *honoris causa* of the University of Paris

DR. THOMAS BARBOUR, professor of zoology at Harvard University and director of the Museum of Comparative Zoology and the University Museum, has been elected a member of the board of trustees of the Carnegie Institution of Washington

DR. P W WHITING will have charge of the work in genetics during the present term at the University

of Pennsylvania, where he is a guest lecturer in zoology

DR. HOWARD WALTER FLOREY, of Magdalen College of the University of Oxford, has been appointed professor of pathology

DR LEO ROGIN, lecturer in economics at the University of California, who has been acting chief of the food products division of the Labor Advisory Board, has been made chief of the division

DR. H J FRASER, of the department of geological research of the International Nickel Company, Ltd, is spending some months in the laboratory of Dr L C Graton, professor of mining geology at Harvard University, on special microscopical investigations of the Sudbury ores

DR ALBERT F BLAKESLEE acting director of the department of genetics of the Carnegie Institution of Washington at Cold Spring Harbor, was elected on January 28 a corresponding member of the Academy of Sciences of the Institute of France He takes the place in the section of botany made vacant by the death of Professor Chodat, of the University of Geneva The other foreign correspondents in the botanical section are Professor Ikeno of Japan and Professor De Vries of Holland According to the last published records, the correspondents in this country from the other biological sections of the French Academy are the following Dr Alexis Carrel, of the Rockefeller Institute for Medical Research, Dr Simon Flexner, director of the Rockefeller Institute, and Professor T H Morgan, of the California Institute of Technology and research associate of the Carnegie Institution of Washington

ALFRED KNIGHT, fellow of the Royal Astronomical Society and formerly vice president of the Fleischmann Company, was elected president of the American Institute of the City of New York on February 14 The other officers elected were Dr Oscar Riddle, *vice president*, L W Hutchins, *secretary*, and H T Newcomb, *treasurer*

DR. CHARLES E DECKER, professor of geology at the University of Oklahoma, has been elected president of the Oklahoma Academy of Sciences

AT its meeting on February 6, the executive committee of the American Geophysical Union appointed a special committee on continents and continental evolution as follows W T Thom, Jr (*chairman*), L H Adams, N L Bowen, W Bowie, R T Chamberlin, E Cloos, M Ewing, R M Field, J A Fleming, W R Gregg, B Gutenberg, N H Heck, M K Hubbert, E S Larsen, F W Lee, L D Leet, J B Macelwane, L. B Slichter and H R Wanless The object of this committee is to apply geophysical methods and technique to the solution of the geological problems of continental genesis and evolution, and its work will integrate closely with that of the union s special committee on geophysical and geological study of oceanic basins The special committee on continents and continental evolution therefore includes men from the following fields Chamberlin, structural geology, Wanless, stratigraphic geology, Field, particularly because of his chairmanship of the special committee on geophysical and geological study of oceanic basins, Larsen, volcanology, Cloos, Ewing, Hubbert, Lee, Leet, Slichter and Thom, general geophysics and applications to geology, Bowen, geochemistry, Adams, physics of rocks, Bowie, gravity and isostasy, Gutenberg and Macelwane, seismology, Heck seismology and terrestrial magnetism, Fleming, terrestrial magnetism and electricity, Gregg, meteorology The union feels that the simultaneous application of geophysics and geology in an attack upon the major problems of earth composition and evolution can not fail to lead to great advances in earth science

THE George Fisher Baker non resident lecturer in chemistry at Cornell University for the second term of the academic year, 1934–35, will be Professor Farrington Daniels, professor of chemistry at the University of Wisconsin His lectures on "Chemical Kinetics" will be given in Baker Laboratory on Tuesdays and Thursdays at 12 o'clock

PROFESSOR E WIGNER of Princeton University, addressed the Physics Colloquium of the University of Pennsylvania on the subject of "Free Electrons and the Metallic Bond" on January 24

DR. WILLIAM K GREGORY professor of paleontology at Columbia University and curator of comparative and human anatomy at the American Museum of Natural History, delivered a lecture entitled "The Study of Human Evolution A Plea for a More Synthetic Approach' before the University of Maryland Biological Society in Baltimore on January 29

DR SAMUEL ALFRED MITCHELL director of the Leander McCormick Observatory of the University of Virginia, will give an illustrated lecture on 'Solar Eclipse Problems' at the meeting of the American Philosophical Society on March 1

PROFESSOR ARTHUR B RECKNAGEL, professor of forestry at Cornell University, spoke before the Canadian Society of Forest Engineers at the University of Toronto on January 21 on "Applied Forest Management under the Lumber Code in the Northern States" On January 25 he read a paper on "American Conservation Measures and Rules of Forest Practice" at a meeting of the Canadian Pulp and Paper Association in Montreal

DR. GUSTAV EGLOFF recently gave a series of lectures as follows On January 17, before the Northwest Petroleum Association in Minneapolis, on "Modern Products from Petroleum", on February 7, at a conference on fuel oil and oil burners at the University of Wisconsin, on "Production, Competitive Uses and Future Supply of Fuel Oil", on February 7, at a meeting of the Northeast Wisconsin section of the American Chemical Society, on 'The Cracking Process and Its Products", on February 14, before the Ohio Petroleum Marketers Association, Inc, Columbus, Ohio, on Modern Gasoline and Lubricants

DR WOLFGANG KOHLER professor of psychology at the University of Berlin, lectured on the subject, "Biology and Physics,' before the Rutgers University chapter of the Sigma Xi on January 21

ON January 17, Dr James E Ackert, dean of the division of graduate study and professor of zoology at the Kansas State College, addressed the University of Kansas chapter of Sigma Xi on the subject, 'Host Resistance to Parasitism"

JAMES I HAMBLETON, of the Bee Culture Laboratory of the U S Department of Agriculture, and Dr Ronald Bamford, of the department of botany of the University of Maryland, have been recent speakers before the Western Maryland College chapter of Beta Beta Beta Mr Hambleton spoke on November 27 on 'The Bee as a Honey maker," and Dr Bamford on January 29 on 'Some Chromosome Problems'

FRANS BLOM, director of the department of middle American research at Tulane University, left on February 12 on an archeological expedition to Honduras He was accompanied by Jens Yde, of the Danish National Museum

DR. ARTHUR A ALLEN, professor of ornithology at Cornell University, on February 13 left for an expedition through the South and West to record and study bird songs The expedition is under the auspices of the American Museum of Natural History and Cornell University and will be in the field until August 1

MEMBERS of the committee appointed to organize the celebration of the three hundredth anniversary of the founding of the chemical industry in America, to be held in connection with the meeting of the American Chemical Society in New York from April 22 to April 26, are Dr Francis P Garvan, president of the Chemical Foundation, *honorary chairman,* Dr Arthur W Hixson, professor of engineering at Columbia University, *general chairman,* Dr Lawrence W Bass, director of research of the Borden Company, New York, N Y, *vice chairman,* Dr D P Morgan, chemical economist of Scudder, Stevens and Clark, New York, N Y, *secretary treasurer*

WILLIAM H TYERYAR, of Frederick, Maryland, has contributed to the Western Maryland College his collection of butterflies and moths, containing over 2,000 specimens, all caught in Frederick and Carroll counties, Maryland

A GRADUATE of the University of Kansas, whose name is withheld, has recently given $60,000 for the construction of the first unit of a Children's Hospital for the Kansas University School of Medicine Construction will begin at once

COLUMBIA UNIVERSITY has announced the following gifts $5,300 from the Josiah Macy, Jr, Foundation for work in pathology, $3,150 from E R Squibb and Sons for fellowships in the departments of biological chemistry and anatomy, $2,000 from the Emergency Committee in Aid of Displaced German Scholars for the salaries of visiting scholars, and $1 500 from Mrs Elsie Clews Parsons for research in anthropology

A NEW quarterly, devoted to the publication of mathematical research and sponsored by Duke University, will appear shortly under the title *Duke Mathematical Journal* The editors are A B Coble, University of Illinois, D V Widder, Harvard University, and J M Thomas, Duke University, the last named being managing editor The associate editors are H E Bray, L W Cohen, L R Ford, J J Gergen, R E Langer, C C MacDuffee, J A Shohat and G T Whyburn The first number will be dated March, 1935

THE National Research Council announces that a limited number of fellowships in the physical sciences, namely, physics, chemistry, astronomy and mathematics, will be available for use during 1935–1936 Applications must be filed on or before March 1, on forms obtainable from the secretary of the fellowship board in physics, chemistry and mathematics of the National Research Council A year book describing the fellowships, stipends, conditions and tenure may be obtained upon application to the secretary

AN enlarged program of teaching and research in mathematical statistics is being undertaken at Columbia University this year Research under the auspices of the Carnegie Corporation is being conducted with Professor Harold Hotelling as director, with a view to clarifying the foundations of statistical methods and extending their scope, and particularly in the development of tests of significance and criteria of accurate estimation For this work Dr Joseph L. Doob has been appointed research associate, and Margaret H Richards and William G Madow research assistants. Professor Felix Bernstein, founder and formerly

head of the Gottingen Institute of Mathematical Statistics, is at Columbia this year as visiting professor of mathematics A course of training in mathematical statistics has been arranged by the coordination of courses in the departments of mathematics, economics and astronomy to dovetail together without overlapping This work is designed for students familiar with calculus and higher algebra. It includes probability, taught by B O Koopman, statistical inference, by Harold Hotelling, mathematics of heredity and evolution, by Felix Bernstein, training in the use of card tabulating and calculating machines, interpolation and finite differences, by W J Eckert, mathematical economics, by Harold Hotelling, and a seminar in advanced mathematical statistics In addition there are at Columbia University numerous other courses in statistics designed for students in particular fields

We learn from the Associated Press that the Haskell Laboratory of Industrial Toxicology has been established by E I du Pont de Nemours and Company The laboratory was opened on January 22 on the grounds of the experimental station of the company near Wilmington The new laboratory has been established because of the growth of the chemical industry in this country It will be housed in a three story building planned in thirty units, and has been named for Vice President Harry G Haskell The function of the laboratory will be to study the effects of new products upon the health of employees during manufacture, and, prior to these new products being placed on the market, to study their possible effects on public health Dedication of the laboratory took the form of a scientific meeting presided over by Frank C Evans, director of the service department of the du Pont company

DISCUSSION

UPTHRUST—A GEOLOGIC TERM

In a recent, discriminating review of Geologic Structures,"[1] the reviewer unwittingly gave the senior author of that manual special satisfaction by singling out for commendation certain chapters written by the junior author, but he also criticized a lack of definition in the use of the term *upthrust*, for which the senior is responsible Webster gives the definition Upthrust, n An upward thrust, specif Geol, an uplift of part of the earth's crust" That might be regarded as adequate, but the writer has allowed the word a certain freedom to be verb or adjective, as well as noun He has designated an upthrust mountain, the Sierra Nevada of California, for instance, an upthrust The fault which characterizes its eastern face he has called an upthrust fault or an upthrust in that connotation He might refer to the movement itself as an upthrust or upthrusting And he would defend each of these uses or any others in which the connection showed clearly in what sense the word was used He holds that precise definitions deaden style and often obscure meaning, sometimes indeed they cloak ignorance He would preserve for English words the freedom in which they have grown up He opposes placing them in solitary confinement, in the narrow cell of a scientific strait jacket, better that Greek or Latin supply the victims However, the reviewer wants a definition His question is What is an upthrust fault? In response one may say *An upthrust fault is a high angle fault on which the displacement involved the demonstrable elevation of one side (or both) above its former position with reference to sea level* The designation "high angle" implies that the dip of the fault plane exceeds 45° It is usually between 70° and 90° *Upthrust* is thus distinguished from *overthrust*, which is the term applied to displacements on planes dipping less than 45° It will be noted further that the definition does not include the direction of dip of the upthrust fault, whether toward the upthrow or the downthrow In fact the dip may be toward either or in different parts of the same displacement, here toward one and there toward the other, for such fault surfaces are frequently curved An upthrust fault may thus be either normal or reverse or may be a hybrid of both types Considering the forces involved in such displacements it is clear that gravity is one and that an anti gravity stress must also act If the latter is the more effective there is upthrusting, if the former prevails there is subsidence, *i e*, gravity faulting aided possibly by a downward directed stress In large structures both effects may be represented, as for instance in the case of the Dead Sea Trough There the Judean Peneplain or Matureland is elevated in the high plateaus and also depressed below sea level in the trough The fault between the two segments is a high angle fault, approaching 90° With reference to the plateaus it is an upthrust or ramp, with reference to the trough it is a gravity fault or downthrust It may be either normal or reverse, according to the direction of dip in any particular section Upthrusts and upthrust faults are of common occurrence in mountain ranges and plateaus and they are also of many types Let us keep the generic term free to serve us in the many

[1] Science, 80 2085, 562, December 14, 1934.

useful relations in which it can serve adequately so long as it retains its fine old English meanings

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ALTERATIONS IN THE FOUNDATIONS OF THE EXACT SCIENCES IN MODERN TIMES

IN an article appearing in the October 5 issue of *Die Naturwissenschaften* under the title, 'Wandlung der Grundlagen der Exacten Naturwissenschaften in jungster Zeit," Professor W Heisenberg, theoretical physicist of the University of Leipzig and recent Nobel prize winner, has presented his views on the effects induced in the general scheme of exact sciences by the revolutionary physical discoveries of the past thirty five years This presentation is a particularly inviting one, coming as it does from one of the young leaders in theoretical physics, for to such a man, who will undoubtedly be a prominent figure for many years to come, it must be considered an urgent necessity that the importance of the field of science in which he has worked is clearly understood and appreciated For this reason Heisenberg is careful to point out the various links between the exact sciences themselves and between these and the affairs of everyday life The manner in which this is done is probably best illustrated by a survey of the text of the article Such a survey is given in the following paragraphs

The two major additions to the fields of physics which have been made in the past thirty five years are those summed up in the expressions, "Relativity Theory' and 'Quantum Theory," and were heralded by the discovery of the quantum of action by Planck and the propounding of the special theory of relativity by Einstein Previous to this, in the period of so called classical physics, all fields were underlain by a set of basic conceptions which were taken as unquestioned facts and which were the guiding principles of all investigations In the words of Heisenberg

> Physics dealt with the behavior of real entities in space and their variation in time Although merely the character of experiences underlying physics was specified by this, a number of conclusions were drawn concerning the properties of such entities at the same time One was led to the unexpressed viewpoint that the occurrence of events in time and space is independent of observation, and moreover, that space and time constitute mutually independent classifying categories of events and in this rôle represent an objective reality that is common to all men

The underlying assumptions of classical physics were contested by the special theory of relativity which found its experimental basis in the well known work of Michelson and Morley that yielded results contradicting the classical concepts From the new view point the classical concepts of an absolute past and future, separated by an instantaneous present that is the same for all observers, were abolished and supplanted by the view that the absolute past and future of two observers is separated by a finite stretch of time which depends upon the relative conditions of observers These newer views have since received abundant enough experimental verifications that they may now be taken as definite facts of the exact sciences in the same sense as that in which the principles of classical mechanics and thermodynamics are accepted

In order to emphasize the fundamental importance of this change in attitude Heisenberg states

> The extraordinary significance of these facts lies, in the first place, in the completely unexpected realization that the natural result of following the route indicated by classical physics compels a change in the foundations of this field Modern theories do not arise out of revolutionary ideas that are, so to speak, brought in from the outside of exact sciences, they are the results of investigations undertaken with the desire to carry out the program of classical physics Therefore, at this point one can not compare the beginnings of modern physics with the great revolutions of the past, that is, for example with the work of Copernicus, the ideas of Copernicus were, to a great extent, introduced into the conceptual scheme of contemporary physics from the outside

The general theory of relativity has revised the concepts of the geometrical properties of space time and has established a connection between the geometry of the world and the distribution of matter in it Its experimental justification is not as firmly established as that of special relativity, but it has met no contradiction The principal conviction of its truth lies in the fact that it presents many stimulating view points that were previously overlooked The fact that the fundamental postulate that the geometry of the world depends upon the distribution of matter does lead to a completely self consistent picturization of gravitational phenomena causes one to anticipate that additional progress will be made on the basis of this theory rather than from a wholly new one, even if experimental contradictions do appear in the future

The foundations of quantum theory, like those of relativity, arise out of the attempt to extend the classical domain rather than from the introduction of radically new ideas On the basis of Planck's discovery, the investigations of Lenard and Einstein necessarily led to the adoption of a corpuscular view-point, that is, the classical wave theory was contradicted in performing an experiment suggested by classical reasoning In exactly the same way, each stage of development of quantum theory up to the present time has been required by contradictions in the previously

accepted scheme Heisenberg believes in the permanence of many elements of the present theory, in which there exists a curious division between the laws describing the observing apparatus and observed object, the first being discussed naturally in terms of classical views and the second in terms of a complex mathematical formulation, since he regards the second as almost unique If this is granted, then he believes that the statistical interpretation of quantum theory is almost unavoidable since it is the only means of bridging the gap between the rigid determinism of classical physics, on the one hand, and the fact that the influence of the measuring apparatus on the observed object is indeterminate because of the nature of the quantum laws, on the other In answer to the question often asked as to whether or not there exists a set of purely deterministic laws of such a nature that the present-day quantum mechanics takes the same position as Boltzmann mechanics did in the classical theory, Heisenberg answers

> An exact investigation of this hypothesis indicated at once that these natural laws will be in contradiction with the results of quantum mechanics which are already rigorously established, at no place does quantum mechanics leave room for an extension of its consequences, for the only point at which it contains an indefinite feature is at the division mentioned previously If one would remove the indefiniteness of quantum theory by extensions at any point defined by natural processes it would be necessary to remove the division from the place which we have assigned it, and the contradictions between quantum theory and the extension sought for would become apparent

Just as the voyages of Columbus and Magellan brought to an end a period of belief in which the hypothesis of a flat earth was accepted, so in Heisenberg's opinion the new theories have brought the period of classical physics to an end That is, the concepts of absolute time and determinacy are to be considered as out of place in the new physics as the concept of 'the end of the earth" is to day However, the discovery of Columbus did not affect the geography of the Mediterranean Basin in any important respect and in the same way we may believe that certain fields of classical physics, such as mechanics, optics and thermodynamics, will remain unaltered

The general importance to civilization of modern developments in physics may be classified in two groups on the basis of the following facts First, the range of pure science that is available for practical use in the applied sciences is now increased by those fields in which modern physics has stimulated research, and second, the philosophical principles which the new physics yields for exploitation are major additions to the whole of human thought

The development of classical physics brought with it the advances of western civilization that go with the harnessing of power and its use in machines Since modern physics finds an *experimental* basis in the natural course of classical physics, it is to be expected that as great technological strides will follow from it as did from the development of older fields That is, it is just the essential continuity of the step from the physics of the last century to that of the present that makes this applicability inevitable Moreover, since pure science is the spring that feeds all the applied sciences, it is essential for the sake of the continued development of the latter that the former be kept in a state of continuous activity The neglect of this fact can lead only to technological stagnation and the death of all scientific advance

The changes which modern physics has brought to philosophical thought are elaborated considerably by Heisenberg, who has a very deep appreciation of this offspring of the recent work The central topic with which his discussion deals is a general examination of the manner in which modern views curtailed the conclusions that might have been drawn from a complete extrapolation of classical thought That is, the basis of classical physics was mechanistic in essence and if one exploited these concepts to the limit in a purely abstract way, it was necessary to conclude that the entire universe is to be likened to one machine started at an indefinite period in the past and running toward a fixed destination which can not be altered by means of any internal agency However, the practical attempt made at carrying these principles to the limit led, as we have seen, to the modern developments, from the standpoint of which the extrapolation is meaningless

In a similar way, one might have attempted to approach an understanding of ultimate reality through classical lines, and again succeeding developments would compel one to abandon any conclusions that might have been drawn The general view to be gained from facts of this kind is that any field of thought may be expected to yield the answer to only a limited field of questions An attempt made at extension in a purely abstract manner will lead to results that can not be true In this connection Heisenberg states

> Thus Nature influences modern natural science more than the earlier form in such a way as to place the old question of the realization of reality upon a new basis and to answer it in a new manner Previously the pattern of exact science led to a philosophical system in which a definite truth—perhaps the "Cogito ergo sum" of Descartes—was the starting point from which all problems of world view were to be attacked Nature in modern physics has reminded us clearly, however, that we

may not hope to reach the entire region of the understandable from such a fixed basis of operation Instead, we shall always come to essentially new knowledge in the manner of Columbus who had the courage to leave every thing but the knowledge of known land behind with the determined and devout hope of finding land again on the other side

Just to what extent this view may be continued is of course an unanswerable question, but at any rate it indicates the path which the science of the near future must follow and may lead to a further unification of those concepts of existence with which science can deal

FREDERICK SEITZ

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FURTHER COMMENTS ON THE TRIHYDROL CONTROVERSY

IN a recent review[1] of the properties of water and their possible biological significance by Dr Jahn and myself we made the following remark (p 326) It is hoped that our work on the biological effect of ice and steam water will stimulate more extensive research on the properties of water even if this proves fatal to our present working hypothesis that trihydrol aggregates play an essential rôle in certain types of living cells" At the time of the first experiments indicating the stimulating action of ice water the only published physical test of the rate of attainment of polymer equilibrium indicated a considerable hysteresis effect during the exhaustion of the ice-forming power of water Since that time several chemists and physicists, although skeptical of the stimulating action of ice water, have afforded ample evidence of the psychological stimulation of our work on water research Menzies, LaMer and Miller, Ellis and Sorge and more recently Dole and Wiener, although not repeating our procedure, have published what they consider to be negative evidence

Dole and Wiener[2] tested my trihydrol hypothesis by determining the density of recently condensed water which had been partially frozen Under these conditions no difference in density was found Only four fifths of the water was frozen, and moreover these rapidly frozen small samples of water do not yield large crystals from which the best biological results are obtained Dole points out that trihydrol is supposed to have a lower density than dihydrol, but he completely overlooks the fact that the lower polymer monohydrol, which may be enriched in recently condensed steam water, has like trihydrol a low density Density determinations then would be of very ambiguous significance for the comparison of two water samples, each supposedly having a slightly enriched polymer of low density That monohydrol has a bulky structure is seen in the solution volume curves of Bousfield and Lowry, in which a contraction appears at higher temperatures resembling the contraction at lower temperatures due to the breakdown of the trihydrol molecules of large specific volume Moreover a slight change in the configuration of the quartz like structure of water of Bernal and Fowler would not show great density differences It is also possible that the H-O-H angle or the activity of *auxiliary fields undergoes a temporary change*

Dole and Wiener also determined the density of water from recently melted clear block ice in which crystal growth had occurred This water had an excess density of 2 4 parts per million compared to recently condensed water In this connection the authors fail to consider the hypothesis of Uhlmann that the sublimation of aged ice may concentrate the heavy hydrogen isotope, which may possibly account for the enhanced biological effect of water from old samples of natural ice Moreover, Gilfillan[3] finds that fractional crystallization of water concentrates the heavy hydrogen isotope to a slight extent (which, however, is complicated by the fact that O^{16} is concentrated in respect to O^{18})

It should also be pointed out that Dole and Wiener worked at a higher temperature (23°) than that at which our biological experiments are usually carried out (10°) There is evidence that the attainment of polymer equilibrium is more rapid at higher temperatures Also in some of our tests a continuous stream of ice water was used or the cells were temporarily exposed to the ice water at a lower temperature than that of the recently condensed water

There are, of course, several positive tests for the differences between ice water and steam water On the physical side it has been found that the onset of freezing, the exhaustion of the ice-forming power of water and the diamagnetic susceptibility indicate a polymer lag On the biological side the most recent evidence is that of Hegarty and Rahn, who find that recently condensed water retards bacterial growth which can not be an impurity effect, for this property disappears after a few hours Moreover, the water samples were bubbled with air to prevent a gas effect Even Professor Menzies, an ever vigilant critic of my ice water work, admits the possibility that the biological method may be more sensitive than some of the physical tests

It appears that all these difficulties are in large *part due to the unsatisfactory state of our knowledge* of matter in the liquid state Maass and Steacie[4]

[1] T C Barnes and T L. Jahn, *Quart Rev Biol* 9 292, 1934 This review contains references to papers mentioned in this note

[2] M Dole and B Z Wiener, SCIENCE, 81 45, 1935

[3] E S Gilfillan, *Jour Am. Chem Soc*, 56 2201, 1934

[4] O Maass and E W R Steacie, "An Introduction to Physical Chemistry," New York, 1931

contrast the relative simplicity of the solid and gaseous state with the "great complications" which arise in the physical properties of associated liquids From the biologist's point of view it is unfortunate that vital phenomena appear to be manifested by liquids and not by gases or crystals

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SCIENTIFIC BOOKS

A NEW DICTIONARY

Webster's New International Dictionary Second Edition pp i–xcvi 1–3210 G and C Merriam Company, 1934 $20 00

ONE scarcely thinks of an unabridged dictionary as a botanical reference book, yet it is the one work generally accessible to all readers to which they may turn for the spelling, meaning, pronunciation and derivation of hundreds of botanical terms or for brief information about thousands of different plants In the definition of non botanical words, botanical users of the dictionary can certainly rely with confidence on its accuracy and inclusiveness They will naturally have a greater interest in its treatment of the huge botanical vocabulary of plant names and technical terms

The English language is remarkable for its world wide use and for the readiness with which it assimilates foreign nouns Plants of economic value always have local names, and an extraordinary number of such names have found English use Opening the book at random, I find these plants included and defined by reference to the species or to the genus when the name so applies lace bark (4 kinds), lace fern (2 kinds), lace flower (3 kinds), lace grass lace leaf, lace plant (2 kinds), lace tree, lace vine, lace wood, Lachenalia, Lachnanthes It is obviously not within the province of a dictionary to give a diagnosis of every plant, nevertheless a surprising amount of information is presented *Titi*, for example, is defined as a tree (*Cliftonia monophylla*) of the southern United States, having glossy leaves and racemes of fragrant white flowers succeeded by one seeded drupes, the name is also used for the related genus *Cyrilla*, in South Carolina for the sorrel tree, and in Australia for *Cordyline terminalis* Turning now to these genera, we find that the last is a small genus of Old World plants of the Liliaceae, with *Taetsia* as a synonym, *Cyrilla* is the typical genus of the Cyrillaceae, and *Cliftonia* a monotypic genus of the same family The Cyrillaceae are referred to the order Sapindales, which is also briefly defined Even the synonym *Taetsia* is entered Of course the dictionary is not an *index generum*, and one easily notes numerous omitted generic names of unimportant plants, such as *Sclerolepis* Apparently all family names are entered and referred to their order Opinions are even expressed concerning the validity of some names the Leguminosae, for example, are defined as a group and stated to contain three separate families The Guttiferae strange to say, are mentioned among the rare or obsolete words at the bottom of the page, notwithstanding their recognition by Engler and Prantl, although the segregates Hypericaceae and Clusiaceae are listed In nomenclature, the rules of the revised International Code of 1930 have been followed as far as possible, but care has been used to avoid the publication of new names Altogether, the list of vernacular names is remarkable for its length and completeness and surpasses any preceding list in any language, while the list of genera is second only to Willis' Handbook in its general utility

Botanical terms must have offered a serious problem to the editor Every botanist feels it his right to coin new terms of Greek or Latin derivation, and many of them are never used except by their author Every one of these must be discovered in literature, a task of no mean proportions on every one a decision must be made as to the appropriateness of listing it, for every one a definition must be formulated Since earlier definitions do not exist, the original use of the word must be studied and its meaning derived *de novo* Among the recent terms not included in the edition of 1928, but defined in the new edition I note the following amphisporangiate, association, consociation, consocies crossover, cultigen, ecesis, euploid, heteroploid, hydrarch layer, sciophyte, sere, succession, trisomic and xerarch, and the list could easily be extended greatly As a botanical glossary, the dictionary is obviously the most complete work extant

A special table of ferns occupies two columns and gives the common name, scientific name, geographical distribution and use of all species which have an English name A similar table of grasses occupies no less than two columns There are full page plates, mostly in color, illustrating orchids, poisonous plants, state flowers, trees and wild flowers, while hundreds of text figures aid in the clear definition of an equal number of terms

Mr Norman Taylor was the general editor for botany and was assisted by a staff of specialists One of these was my colleague, the late Arthur Hollick, and I had several opportunities to observe the meticulous care with which paleobotanical definitions were prepared The editor, his assistants and the publish

ers are all to be congratulated on a distinct botanical achievement

H A GLEASON

NEW YORK BOTANICAL GARDEN

THE MEMOIRS OF A BOTANIST

Erinnerungen und Welteindrucke eines Naturforschers By HANS MOLISCH Pp 232 Emil Haim, Wien and Leipzig 1934, Rm 9 00

WHAT makes the reading of botanical history so interesting are accounts of the personalities who participated in the advancement of this branch of science Here belong the memoirs of outstanding botanists, especially of men whose leadership has contributed as much to botanical progress as their own research work One of these men is Hans Molisch His latest book is fascinating because of the many problems which occupied him during his life, the many botanists whom he met and the broad cultural background of his life and travels

Molisch was born in 1856 at Brunn in the former Austro Hungarian empire and as a nine year old boy he met Gregor Mendel who was a neighbor and friend of the family From his father, who was a horticulturist and commercial florist, Hans Molisch acquired in his youth a practical knowledge of gardening which in turn aroused his interest in theoretical botany and especially in plant physiology This early training showed itself in a later book on Plant Physiology as a Theoretical Basis for Horticulture (1915) There, Molisch said, the plant physiologist should learn from the practical horticulturist and the latter in turn from the physiologist It became his most popular book and has had six editions to date, besides being translated into several languages

Molisch attended the University of Vienna, where he became Wiesner's assistant Later he taught at the Technische Hochschule in Graz where the author of this review was one of his students From Graz he was called to the German university of Prague and finally, as Wiesner's successor, to Vienna

A considerable portion of the book is devoted to observations of tropical plant life during a visit to Buitenzorg in Java in 1897 98 On his return trip Molisch visited the United States From 1922 to 1925 he taught plant physiology in the University of Sendai in Japan where he had been called to organize the botanical division of the newly founded institute of biology After his retirement from the University of Vienna, Molisch taught for one year (1928–29) at the institute for plant physiology of Sir Jagadi Chandra Bose in Calcutta and traveling home he again visited the United States He always showed great interest in the botanical work done in this country and had accepted an exchange professorship at Columbia University when the great war broke out, which frustrated this plan

The Erinnerungen gives a detailed account of the research work done by Molisch Among his earlier studies he mentions a histologic chemistry of vegetable foods (1891), a treatise on iron in its relation to plants (1892) investigations about the nutrition of algae the freezing of plants and the luminosity in plants Fruits of his first visit to the tropics were researches about the forming of indigo, of palm wine and about the secretion of water by liana stems He was always greatly interested in plant chemistry and in 1913 he published a Microchemistry of Plants," of which three editions have appeared to date His book on plant physiology and horticulture (1915) has been mentioned The three years in Japan resulted in a volume entitled Plant Physiology in Japan on the Basis of Personal Observations' (1926) and the more personal experiences of this trip found their expression in a book In the Land of the Rising Sun" (1927) The observations gathered during his second trip to India are contained in a book entitled A Naturalist in India' (1930) Even after retirement from teaching such contributions were made by Molisch as Duration of Plant Life (1929) and Plant Chemistry and Plant Relations' (1933) Naturally all Molisch's books are written in German and the titles as given in this review are translated into English

Any student of botany who can read German fairly fluently will find the Erinnerungen und Welteindrucke eines Naturforschers' easy and pleasant reading and will enjoy making the acquaintance, through this book, of an excellent botanist and a most delightful personality

A C NOÉ

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REPORTS

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AS announced in SCIENCE for January 18, 1935, the National Research Council has been given funds for grants in aid for the year 1935 Applications for grants from this fund must be in the hands of the secretary of the Committee on Grants in Aid on or before April 1, 1935 Additional information and blank forms for filing application will be furnished upon request Action on these applications will be taken about the middle of May

At meetings in November and December, 1934, the

Committee on Grants in Aid made the forty four following awards

PHYSICAL SCIENCES

J W Beams, professor of physics, University of Virginia, "investigation of Allison's magneto optic method of chemical analysis", P Gerald Kruger, assistant professor of physics, University of Illinois, "artificial radioactivity", M Stanley Livingston, instructor in physics, Cornell University, "high speed ions", Overton Luhr, assistant professor of physics, Union College "source of helium ions", Walter C Michels associate professor of physics, Bryn Mawr College, "temperature variations of the photoelectric effect", Rose C L Mooney, assistant professor of physics, Newcomb College, Tulane University, "x ray crystal structure", J C Stearns, professor of physics, University of Denver "cosmic rays", Joel Stebbins, director of the Washburn Observatory, University of Wisconsin, "photometry of stars"

ENGINEERING

Walter G Whitman, professor of chemical engineering, Massachusetts Institute of Technology, "gel structures in the setting of cement"

CHEMISTRY

J R Bates, L S Anderson and J C Halford, assistant professors of chemistry, University of Michigan "Raman spectra of compounds of deuterium" Ralph A Beebe, associate professor of chemistry, Amherst College, "measurement of the heats of adsorption of gases on solid adsorbents at low temperatures" Malcolm Dole, instructor in chemistry, Northwestern University, "studies on the glass electrode", W George Parks assistant professor of chemistry, Rhode Island State College, "the e m f method for determining heats of dilution and transfer"

GEOLOGY AND GEOGRAPHY

Kenneth F Caster, instructor in geology, Cornell University, "the stratigraphy and paleontology of the Pocono formation of Pennsylvania and adjoining territory", Maurice Ewing, instructor in physics, and Albert P Crary, assistant in physics, Lehigh University, "a geophysical investigation", Frank F Grout, professor of geology, University of Minnesota, "the mechanics of igneous action", Elmer H Johnson, industrial geographer, Bureau of Business Research, University of Texas, "physical and economic characteristics of the natural regions of the Gulf Southwest", George W Rust, post graduate student in geology, University of Chicago, "studies of a newly discovered center of ancient volcanic activity in southeastern Missouri", J Russell Whitaker, assistant professor of geography University of Wisconsin, "regional geography of southern Ontario"

MEDICAL SCIENCES

G Howard Bailey, associate professor of immunology, School of Hygiene and Public Health, Johns Hopkins University, "the heterophile antigens of bacteria", David M Greenberg, associate professor of biochemistry, University of California "the effect of diets low in magnesium on Vitamin G requirement" Louis N Katz, director of cardiovascular research, Michael Reese Hospital, assistant professor of physiology, University of Chicago, various factors operating to modify the coronary blood flow" Pearl Kendrick associate director Bureau of Laboratories, Michigan Department of Health, "the antigenic properties of bacillus pertussis", Albert P Krueger, associate professor of bacteriology, University of California, "the nature of bacteriophage", Orthello R Langworthy, associate professor of neurology Johns Hopkins University Medical School, "control of the urinary bladder by the peripheral and central nervous system" J P Quigley assistant professor of physiology, School of Medicine, Western Reserve University, "the rate of absorption of oxygen from the intestinal lumen of unanesthetized dogs" H D Senior, professor of anatomy, University and Bellevue Hospital Medical College, "the anomalies of the limb arteries in embryos"

BIOLOGICAL SCIENCES

Ernest Anderson professor of chemistry University of Arizona, "the polyuronides of woods", Robert K Enders, assistant professor of zoology Swarthmore College, "the myology and general anatomy of Didelphids, Alouatta, Cebus and Bats", Denis L Fox, instructor in the physiology of marine organisms Scripps Institution of Oceanography, "physiological effects of deuterium oxide on certain marine animals", F G Hall professor of zoology Duke University "the physiological effects of high altitudes on man and animals", Hudson Hoagland, professor of general physiology, and director of the Biological Laboratories Clark University "repetitive rhythms of activity", Carl L Hubbs, associate professor of zoology, University of Michigan, "interspecific hybridization in fishes", F B Isely, professor of biology, Trinity University Texas, "acridian plant and soil relations" Frank R Lillie, dean division of biology, University of Chicago "the mathematical analysis of feather pattern as affected by sex hormones and thyroxin", H D Reed professor of zoology, and Myron Gordon, Heckscher research zoologist, Cornell University "cytological investigations of certain species of fish", C B vanNiel, associate professor of microbiology, Hopkins Marine Station, "study of the pigments of purple bacteria", John E Weaver, professor of plant ecology, University of Nebraska, "effects of great drought upon prairie vegetation and the relation of natural plant cover to soil erosion"

ANTHROPOLOGY AND PSYCHOLOGY

Forrest E Clements, associate professor of anthropology, University of Oklahoma, "mound sites of the Lower Mississippi prehistoric culture in eastern Oklahoma", T M N Lewis, professor of archeology, University of Tennessee, "archeological sites in Tennessee" Morris E Opler, research assistant in anthro-

pology, University of Chicago, "cultural relationships of Apache tribes", George M Peterson, assistant professor of psychology, University of New Mexico, "the effect of variations in the wave form of an electric stimulus on the response of conscious animals" Otis C Trimble, associate professor of psychology, Purdue University, "analysis of wave form as a determining factor in auditory localization", Wilson D Wallis, professor of anthropology, University of Minnesota, "anatomic lag"

ISAIAH BOWMAN,
Chairman, National Research Council

SCIENTIFIC APPARATUS AND LABORATORY METHODS

REGULATING THE FLOW OF SOLUTION FOR PLANT CULTURES

SEVERAL articles have recently appeared in SCIENCE on devices for securing a slow and accurately controlled flow of a liquid [1] The purpose of the present note is to call attention to the simple and efficient method devised by Shive and Stahl[2] and to describe a modification of this method that permits considerable latitude in regulating the rate of flow

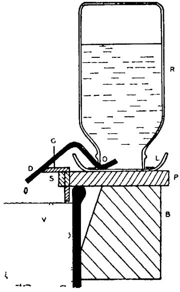

FIG 1

Fig 1 shows the main features of the Shive and Stahl apparatus The solution reservoir (R) is a 2 quart Mason jar with a V shaped orifice (O) that has been cut with a whetstone The reservoir, acting as a Mariotte flask, maintains an approximately constant level of solution in the glass dish (L)—a Woolworth "ash tray" Solution flows at a practically constant rate through the small bore delivery tube (D) and drips regularly into the sand in the culture vessel (V) The apparatus is supported on a platform (P) provided with a bracket (B)

The modification consists in the addition of a notched support (S) for the delivery tube The desired rate of flow through the delivery tube (D) is then readily obtained by adjusting the position of the apparatus on the platform (P) Movement to the right raises the delivery tube (D), since this rests on the notched support (S) and is guided between two wire nails (G), this decreases the "head" and, consequently, decreases the rate of flow through the tube To increase the rate of flow, the apparatus is moved to the left on the platform A change in "head" of about 3 5 cm may be obtained with the apparatus illustrated After the apparatus has been adjusted to the desired rate of flow, a mark is made with a wax pencil on the delivery tube even with the guide nails (G), this allows immediate resetting of the apparatus after the reservoir is refilled

The addition of the tube support allows the rate of flow to be varied through a considerable range, and therefore obviates the necessity of extreme care in the selection of capillary tubing of suitable bore In culture studies the rate of flow may easily be increased as the plants grow

Small fluctuations in the solution level in the reservoir dish (L) occur, since air is admitted intermittently into the reservoir, changes in the temperature of the air in the reservoir also affect the solution level These sources of variation in the rate of flow, though generally not significant in culture studies, may be avoided by employing a separate constant level device, provided with an overflow[3] But the simplicity, compactness and ease of manipulation of the apparatus of Shive and Stahl make it extremely useful in investigations of the mineral nutrition of plants

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THE CHICAGO SOIL-NUTRIENT-TEMPERATURE TANK

THE Botanical Laboratory of the University of Chicago has developed the Wisconsin soil temperature tank into a soil nutrient temperature tank [1] By its use the direct pathogenic effects of deficient soil aera-

[1] J H Wales, SCIENCE 79 545–546, 1934, W A McCubbin SCIENCE 80 144 1934, H F Pierce, SCIENCE, 80 339, 1934, R H Lambert, SCIENCE, 80 361–362, 1934

[2] J W Shive and A L Stahl, *Bot Gaz*, 84 317–323, 1927

[3] S F Trelease and B E Livingston, SCIENCE, 55 483–486, 1922 Pierce, *loc cit*

[1] W H Tisdale, *Phytopathology*, 7: 356–360, 1917, L. R. Jones, *Plant World*, 20 229–237, 1917, J John

tion, metal ions and sharply restricted root development, as well as their indirect pathogenic effects in disposing plants to other deleterious influences, are avoided. It permits growth of control plants that compare favorably in vigor, form, vegetative growth, flowering and fruiting with plants grown in the open in good soil.

The tank itself, a wooden box with a removable galvanized iron container that maintains a constant water level, is the same as that used in the Wisconsin model. A "Sylphon" metal diaphragm thermo-regulator, not shown in the diagram, is used instead of the glass-mercury regulator of the latest Wisconsin tank. Installation of relays, not shown in the diagram, and of insulated heating units is essentially that of the Wisconsin tank.

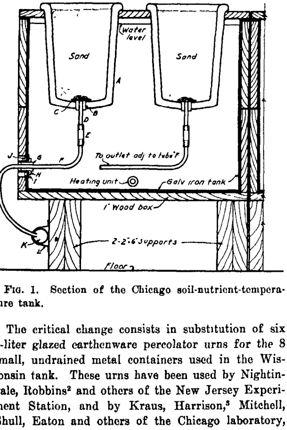

FIG. 1. Section of the Chicago soil-nutrient-temperature tank.

The critical change consists in substitution of six 8-liter glazed earthenware percolator urns for the 8 small, undrained metal containers used in the Wisconsin tank. These urns have been used by Nightingale, Robbins[2] and others of the New Jersey Experiment Station, and by Kraus, Harrison,[3] Mitchell, Shull, Eaton and others of the Chicago laboratory, for constant drip and intermittent application of mineral nutrients to plants grown in nitrogen-free quartz sand. The urns are manufactured by the American Metalware Company of Chicago for use as coffee percolators. The wide-flanged rim of the urn (A) permits its suspension from the lid of the temperature tank into the water bath, and the opening in its bottom permits connection with a drain through the side of the tank.

The drain-hole of the percolator urn is fitted with a one-hole rubber stopper (B) bearing a ⅜-inch glass tube (D) about 3½ inches long. The upper end of the glass tube is fitted flush with the bottom of the urn. Since the tanks are set up in batteries of six, two wide and three long, placed end to end, the outer side wall of each tank is perforated by six one-inch holes, one hole for each of the urns. The holes are drilled through the inner galvanized iron lining and the outer wood case, 2 to 3 inches above the floor of the tank. A ¾-inch Chase galvanized iron lock-nut bushing and an iron washer ⅛-inch thick are soldered into each hole of the metal tank. The washer (I) is placed on the inside and the lock nut (J) on the outside of the metal tank, the washer setting the bushing (H) in far enough so that the metal container is readily placed into or removed from the wooden tank. The bushing is fitted from the inside of the tank with a No. 3 rubber stopper (G) perforated with a ⅜-inch hole. A copper tube (F) ⅜-inch bore is fitted through the hole of the stopper, and the part projecting outside the tank is bent downward sufficiently to carry its end under the edge of the bottom of the tank, where it is inserted into a 1⅝-inch galvanized iron drain-pipe (K). The drain-pipes, one on each side of the battery of tanks, are fastened (L) to the wooden base which raises the tanks about 6 inches above the floor at the point of least elevation. The base is set in about 4 inches from the outer edge of the battery of tanks. The copper tubes are 18 or 24 inches long, depending upon which row of urns they drain. The inner free end of each copper tube is connected by means of a short piece of rubber tubing (E) to the lower, free end of the glass tube projecting through the stopper of the drain-hole of the percolator. The opening in the bottom of the percolator is covered with a mass of glass wool (C) or with an inverted porous flower pot whose drain-hole is covered with glass wool. Good drainage and aeration of the urn are thereby assured, and the likelihood of clogging of the copper drain tube reduced to a minimum. The glazed urn may be filled with soil, or preferably, for controlled nutrition studies, with pure white quartz sand.

The Wisconsin tank has proved an extremely useful instrument for studies in ecologic phytopathology,

son and R. E. Hartman, *Jour. Agr. Res.*, 17: 41–101, 1919; J. G. Dickson, *Jour. Agr. Res.*, 23: 837–870, 1923. In reply to an inquiry relative to the history of soil-temperature tanks, Professor Charles F. Hottes, of the University of Illinois, states that he too had developed a soil-temperature tank that was first installed "late in 1914 or early in 1915." *Neither the Hottes tank nor its use has been described in publications.*

[2] W. R. Robbins, *New Jersey Exp. Sta. Ann. Rpt.*, pp. 178–179, 1927.

[3] C. M. Harrison, *Plant Physiology*, 9: 83–106, 1934.

especially of diseases whose causal complex includes an infective agent It has enabled experimental demonstration that soil temperature, moisture and reaction, singly, or in conjunction with each other and/or with other ecic factors especially air temperature and moisture are part of the etic complexes of infective plant diseases[4] Culture of plants in pure quartz sand in self draining containers has proved an extremely useful tool in physiologic and horticultural studies of the New Jersey and Chicago groups and of many others, and incidentally has contributed to analysis of the causal complexes of non infective pathic events in plants It permits sudden changes in nutrient treatment, such as a complete and rapid flushing with distilled water of all nutrients from the soil, with consequent rapid changes in growth status of the plant It also permits collection of the drip for its continuous or periodic chemical analysis for determination of the pH of the soil solution and for reapplication if desired The Chicago tank combines the advantages of the Wisconsin tank with those of nutritional studies by continuous drip or discontinuous methods of applying nutrients and other ingredients to the plant substrate Coupled with use of shades and lamps, the tank also is suited for analysis of the role direct and indirect of carbohydrate nutrition as a hygro and pathogenic factor in development maintenance and reproduction in plants

The tank has been put to the following uses in the Chicago laboratory a study of the relation of ecic factors to the processes structures and behavior of fruit trees by Dr G T Nightingale of the New Jersey Experiment Station[5] who put the tank to its first extensive use, production and cure of iron excess and deficiency in apple trees by Nightingale and the writer, independently, studies by the writer with the assistance of W S Cook and W S Phillips of the relation of the carbohydrate nitrogen nutrition of the apple tree to its positive and negative disposition to pathogenic infection by *Erwinia amylovora*, studies by Miss E Goldberg of the relation of carbohydrate nitrogen nutrition of susceptible and insusceptible varieties of cabbage, under controlled air and soil temperatures, to their disposition to pathogenic infection by *Fusarium conglutinans* soil borne fungous constituent of the etic complex of cabbage yellows a study by W S Cook of the relation of nutrition of susceptible and insusceptible varieties of tomato to their disposition to pathogenic infection, under controlled air and soil temperatures, by *Fusarium lycopersici*, a soil borne pathogenic fungus, and a study by Miss V Eggers of the relation of nutrition of flax, under controlled soil and air temperatures, to wound healing and regeneration of an axis following experimental decapitation In addition, to determine further the adaptability of the tank, experiments are being started to study the relation of nutrition to (1) healing in apple and pear following non infective and infective wounding and (2) pathogenic infection for (a) wheat and *Puccinia graminis tritici*, (b) cabbage and *Plasmodiophora brassicae*, (c) tomato and *Phytomonas tumefaciens*, (d) tomato and attenuated aucuba and yellow aucuba viruses, and (e) tobacco and *Thielavia basicola* Of these experiments, 2e is being carried out by Miss F L Jewett, the rest by the writer and Mrs H W Wilcox

Results of the experiments indicate that the Chicago tank is well suited for studies, under controlled air and soil temperatures and controlled light and soil nutrient applications of the relation of plant nutrition to (1) non infective pathic events of plants, such as excess and deficiency diseases (2) infective diseases whose etic complex includes an air, insect, water or soil borne virus, schizomycete or filamentous fungus and (3) healing and organ regeneration following non infective and infective wounding of plants

The results also support the proposition that no plant should be designated immune, resistant or insusceptible, and more particularly, genotypically immune, etc, to a particular non living factor or living agent until its disposition to influence by that factor or agent has been tested under a wide range of factors ecically significant for the plant under consideration The Chicago tank is suitable for such testing The results of its use should call attention to the proposition that disposition (susceptibility, insusceptibility) is not an entity but an abstraction symbolizing the observed or probable behavior of an organism or its parts evaluated with reference to their relative capacity for reacting adaptively, non adaptively or apparently not at all, to a given internal or external factor Disposition is always a phenotypic expression a resultant of an interplay of factors internal and external to the biologic system under analysis Acceptance of this proposition is one conceptual means of bridging the chasm that exists in the thinking of many between genetics and developmental physiology The so called 'genotypic' disposition is not a preformed material or immaterial something passed from parent or parents to progeny, but an analytic isolate from the causal complex of that phase of behavior designated as disposition It symbolizes, in part, the relatively invariant ingredients and their organization that an individual receives from parent or parents Possibly results obtained through use of the Chicago tank and similar tools may help to repair some of the mischief done in biologic speculation and experimen

[4] L R. Jones *Trans Wis Acad of Sciences Arts and Letters* 20 433–459 1922

[5] G. T Nightingale, *Bot Gaz*, 1935

tation through unconscious hypostatization of disposition, including aggressivity, pathogenicity and virulence, and of similar concepts common to physiology, pathology and genetics

Details of the experiments will be published elsewhere

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SPECIAL ARTICLES

THE ROLE OF THE CARBAMINO COMPOUNDS IN THE TRANSPORT OF CO_2 BY THE BLOOD[1]

SINCE Siegfried[2] first prepared salts of carbamic acid by the reaction of CO_2 and amino acids, and demonstrated analogous compounds of CO_2 and proteins in quite alkaline solutions, the rôle of these carbamino compounds of protein, particularly hemoglobin as carriers of CO_2 in the blood under physiological conditions has received support by Henriques[3] Margaria and Green[4] and others In a recent paper particularly, Meldrum and Roughton report experiments on the reaction between CO_2 and amino acids as well as hemoglobin In brief they observed that CO_2 was taken up by amino acids or hemoglobin (to which cyanide had been added to inhibit the rapid enzyme catalysis of the hydration of CO_2 to carbonic acid) in two phases (1) a very rapid one which they assert correctly we believe to be due to the formation of CO_2 in the carbamino form and (2) a slow uptake which is due to the formation of carbonic acid From their values of carbamino CO_2 in hemoglobin solution calculated from the *rapid* uptake, they constructed 'non bicarbonate or carbamino CO_2 absorption curves for hemoglobin which they assumed to be practically the same for normal blood and for cyanide blood ' They came to the conclusion which at first sight seems strongly supported by their observations, that carbamino hemoglobin plays a very important rôle as a CO_2 carrier in the blood We believe, however, that the above assumption is erroneous because the equilibrium system which they studied was entirely different from the equilibrium system (*i e*, normal blood without cyanide) to which they applied their experimental data Therefore we believe that their conclusions about the physiological rôle of carbamino CO_2 derives no support from these experiments

This paradoxical situation arises as follows An aqueous solution of an amino acid, *e g*, glycine, to which has been added one or less equivalents of base, and which hence contains a concentration of amphanion, $COO\ CNH_2$, equal to the concentration of base when suddenly allowed by equilibration to react with a CO_2 gas phase, forms carbamate *viz*

(1) $COO\ CNH_2 + CO_2 - COO\ CNHCOO + H^+$

In addition CO_2 reacts to form carbonic acid, *viz*

(2) $CO_2 + H_2O - H_2CO_3 = H^+ + HCO_3-$

Both reactions decrease pH, since both carbonic and carbamic acid are about a thousandfold stronger than glycine In consequence the amount of $COO\ CNH$ diminishes in favor of $COO\ CHN_3+$ and a greater pressure of CO_2 is needed to obtain a given concentration of $COO\ CNHCOO$

Now reaction 1 is very rapid even at 0° C whereas reaction 2 is very slow It follows then that if the equilibration is allowed to go on for a short time only (*i e* about one minute at 0° C) the carbamate reaction will be practically complete, while the carbonic acid reaction will be scarcely begun In effect there is an equilibrium established which is one involving CO_2 carbamate and amino acid *but in which no carbonic acid whatever is present* (Case 1) This equilibrium affords a convenient and illuminating laboratory dissection of the reaction but has no counterpart in nature

On the other hand if the equilibration is allowed to go on *sufficiently long* reaction 2 will be *completed* and the equilibrium will also include carbonic acid (as well as its ions HCO_3- and CO_3) and will be entirely different (Case 2) This *complete* reaction is the one which occurs in the blood and therefore the only one of physiological significance

Now Meldrum and Roughton s experiments, both on amino acids and hemoglobin, were especially designed to bring about the first equilibrium only but the experimental facts so elicited were applied without modification to the second equilibrium state and conclusions drawn therefrom apparently without realization that the two systems were different

The complete dissimilarity between these two cases can be shown by our own experiments (Case 1) In Fig 1 is shown the equilibrium curve of carbamino concentration as a function of P_{CO_2} and pH in a 0 1 M glycine solution with 0 05 M of base The curve calculated on the supposition that *no* carbonic acid or its ions are formed agrees with our (unpublished) experiments on amino acids and hemoglobin and Meldrum and Roughton's work on hemoglobin under circumstances eliminating the formation of H_2CO_3 From this curve it is possible to calculate the mass

[1] From the John Herr Musser Department of Research Medicine University of Pennsylvania, Philadelphia

[2] M Siegfried, *Zeits Physiol Chem.*, 44 85, 1905

[3] O Henriques, *Biochem Zeits*, 200 1 *et seq*, 1928

[4] R Margaria and A A Green, *Jour Biol Chem*, 102 611, 1933

[5] N U Meldrum and F J W Roughton, *Jour Physiol* 80 143, 1933

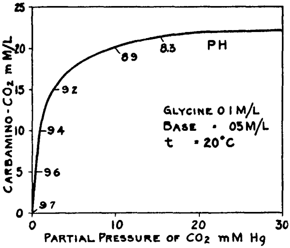

FIG 1 Case 1 Equilibrium curve of 0 1 M glycine (with 0 05 M of base) and CO_2 showing the concentration of carbamino CO_2 as a function of the partial pressure of CO_2 Equilibrium is assumed to exclude the formation of H_2CO_3 or its ions t – 20° C

action constant of the amino acid carbamino CO_2 equilibrium

Case 2 *In Fig 2 the curve of carbamino concentration for the same solution has been calculated from*

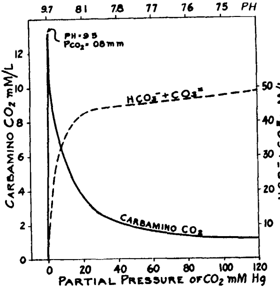

FIG 2 Case 2 Complete equilibrium of 0 1 M glycine (0 05 M of base) and CO_2 showing (carbamino CO_2) concentration as a function of P_{co_2} calculated from the amino acid carbamino CO_2 mass action constant H_2CO_3 and its ions are included

this constant at 20° C, *but in this case the equilibrium includes H_2CO_3 and its ions* The two cases, both in complete agreement with our experiments, are easily seen to be totally unlike Fig 1 shows that the total carbamino concentration approaches half of the base concentration as a limit at high P_{co_2} and that at intermediate values of P_{co_2} the carbamino concentration is high and *increases* appreciably per mm (Hg) change of P_{co_2} Whence by analogy one would conclude that carbamino hemoglobin, if it behaved in a similar way, would be an important carrier of CO_2 in the blood

Fig 2, however, shows that when total rather than partial equilibrium is considered the maximum of carbamino concentration is reached at P_{co_2} 0 1 mm Hg and at a very alkaline pH Moreover, it is only 13 per cent of the base concentration At higher P_{co_2} the curve falls off sharply and at P_{co_2} 50 mm Hg the carbamino concentration is low and *decreases*, but only by a trifling amount, as the P_{co_2} is increased Moreover, it can be easily shown that at $pH < 8$ the carbamino CO_2 is only a small part (< 3 per cent) of the total CO_2

It is this total equilibrium state which corresponds to that of the blood under physiological conditions If hemoglobin behaves similarly to amino acids, the rôle of carbamino hemoglobin as a carrier of CO_2 appears to be relatively insignificant

In addition it must be remembered that carbonic anhydrase, a specific enzyme, enormously accelerates *reaction 2 as has been shown by Meldrum and Roughton*[6] and by Stadie and O Brien[7] Thus the discrepancy between the velocities of the two reactions is wiped out and the possibility of the occurrence of an equilibrium of the first type vanishes This again emphasizes the necessity of considering only equilibrium 2 as being significant in the problem of the CO_2 transport by the blood

WILLIAM C STADIE

REFRACTORINESS TO OVARIAN STIMULATION IN THE RHESUS MONKEY

IN a series of publications Cole and Hart[1,2,3] and their collaborators have described the presence, quantity and biological activity of a gonadotropic substance in the blood serum of pregnant mares Evans, Gustus and Simpson[4] have published a method for the purification and concentration of this gonadotropic substance and have also described its effects on the gonads of male and female rats

[6] N U Meldrum and F J W Roughton, *Jour Physiol*, 80 113, 1933

[7] W C Stadie and H O'Brien, *Jour Biol Chem.*, 1933, 100 lxxxviii, 1933, *Jour Biol Chem.*, 103 521, 1933

[1] H H Cole and G H. Hart, *Amer Jour Physiol*, 93 57, 1930

[2] H H Cole and G H Hart, *Amer Jour Physiol*, 94 597, 1930

[3] H Goss and H H Cole, *Endocrinology*, 15 214, 1931

[4] H M Evans, E L. Gustus and M E Simpson, *Jour Exp Med*, 58 569, 1933

Since this substance manifests biological activity similar to extracts of the anterior pituitary gland containing gonadotropic hormones, it became of interest to determine its effect on the ovaries of immature rhesus monkeys

Each of five immature monkeys weighing between 2,100 and 2,500 grams was injected daily with 5 r u [5] of the gonad stimulating hormone purified by the method of Evans, Gustus and Simpson The periods of injection varied from forty five to seventy days (Some of the monkeys are being injected as this report is being written) Two of five monkeys were injected intravenously and the others subcutaneously Reddening and swelling of the sexual skin (which occurred on the fourth to tenth day after the first injection) were the first indications that the hormone injected was stimulating the ovaries The maximal development of the sexual skin was reached on the thirteenth to twentieth days of the injection period and had returned to interval or castrate type by the twenty seventh to fortieth days

The ovaries were examined and measured at intervals and it was found that very great follicular development had occurred as early as the ninth to twelfth days The size of the ovaries at this time varied in different monkeys, but the average dimensions were of the order of $14 \times 12 \times 7$ mm There was no evidence at any time that corpora lutea had been produced or that ovulation had taken place Examination of the ovaries at the thirty eighth to fortieth days of the injection period showed that they had decreased in size, and in two cases the regression was such that they were of infantile dimensions Such ovaries were white, shrunken structures which did not show any evidence of the many large follicles which had been present earlier

Vaginal lavages were taken daily and a study of these showed that there was an early increase in the number of epithelial and cornified cells with a decrease in the number of leucocytes As the injections were continued, the leucocytes increased in number and the cornified cells gradually disappeared

The decrease in the number of cornified cells and regression of the sexual skin were followed by menstruation in all the monkeys The occurrence of this phenomenon varied between the fifteenth and thirty second days of treatment Menstruation was observed eighty seven days after the last injection in one of two monkeys which had been injected for fifty four days The other monkey began to menstruate on the forty-eighth and again on the eighty second day after the treatment had been stopped

[5] A rat unit is defined as the total amount of hormone which, when administered in daily doses of one cc for three days to immature female rats, causes an increase of approximately 500 per cent in weight of ovaries ninety six hours after the first injection.

We conclude from these data that the ovaries of immature monkeys are first greatly stimulated by the gonadotropic hormone of pregnant mare s serum, but later and during the chronic administration of the hormone they regress to a relatively infantile condition

Zondek[6] has reported that the ovaries of mice which have received chronic treatment with a gonadotropic extract of pregnancy urine first show a great increase in weight, but that after a certain time the weight was normal, although the administration of the extract had been continued Collip and his co workers[7] have reported the same results for rats which have received hypophyseal implants for many days or have been subjected to chronic treatment with placental extracts They[8] have also demonstrated that the blood of rats injected with placental extracts for many weeks inhibits the ovary stimulating effect of such extracts when tested in the immature female rat

We have tested the serum of our monkeys for such an inhibitory effect against the gonad stimulating hormone of pregnant mare s serum If it is present at all in the serum of monkeys before injections were begun, it is there in relatively small amounts, since one cc of monkey serum does not inhibit the ovary stimulating effect of the hormone when tested in immature female rats twenty one to twenty three days of age [9] However, the blood serum acquired an inhibitory action as the injections of the hormone were continued A definite inhibitory effect was obtained with one cc of serum as early as the twenty seventh day of the injection period, and continued administration of the hormone caused the antagonistic effect to become greater Thus after thirty nine days of injections as little as 0 025 cc of monkey serum per day for five days was sufficient to completely prevent the gonad stimulating effect of one rat unit of mare serum hormone However, the usual amount required at this time was 0 05 to 0 10 cc per day

A very definite inhibition of the action of the mare serum hormone has been obtained with serum obtained from a monkey sixty seven days after the injections of the hormone had been stopped

The antagonistic action of the monkey serum exhibits considerable specificity, as evidenced by the fact that the serum did not demonstrate an inhibitory

[6] Cited by J B Collip [7]

[7] J B Collip, *Jour Mt Sinai Hospital* 1 28 1934

[8] H Selye, C Bachman, D L Thomson and J B Collip, *Proc Soc Exp Biol Med.*, 31 1113, 1934

[9] The method of testing for the antagonistic effect consists of injecting x cc of monkey serum per day for five days and one third of a rat unit of gonadotropic hormone per day for the last three of the five days that the monkey serum is being injected The rats are killed 144 hours after the first injection of monkey serum and the ovarian weights compared with those of control animals which have received only one third of a rat unit of the gonadotropic hormone per day for three days

effect toward the gonad stimulating action of human pregnancy urine, whole sheep pituitary gland and whole human pituitary gland extracts, when tested in the immature female rat

Thus an apparent refractory condition of the ovaries of immature monkeys to the gonadotropic hormone of pregnant mare's serum has been produced by chronic treatment with the purified hormone We believe this condition is related to the presence in the serum of the monkeys of a substance which prevents the action of the gonad stimulating hormone

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THE CONTROL OF BRONCHIAL ASTHMA[1]

IN fifty cases of bronchial asthma the attacks of paroxysmal dyspnea have been prevented by a regime of treatment based upon elimination, by postural drainage, of the accompanying bronchial and pulmonary exudate

It is our conception that the fundamental pathological change in bronchial asthma is chronic, non tuberculous pulmonary infection with characteristic[2] hypertrophic and inflammatory change in the lymphoid tissue, thickening and hyalinization of the bronchial and bronchiolar basement membrane, sacculation and ulceration of the bronchial mucosa with marked cellular infiltration The products of this infectious process are the causative factors in the provocation of the asthmatic attack When these products are not permitted to accumulate in the bronchi and lungs the asthmatic attack never occurs

The first therapeutic step is reduction of the viscidity of the bronchial and pulmonary exudate in order to facilitate its evacuation For this purpose elixir of terpene hydrate, guiacol, sodium iodide potassium iodide ammonium chloride and compound tincture of benzoin by steam inhalation have been used singly or in combination

After the viscidity of the exudate is reduced the patient is instructed to kneel on a chair or stool and place both hands on the floor The more nearly the thorax approximates an inverted vertical position the more nearly ideal are the results Compromise positions can be devised for the enfeebled patient While in this position the patient coughs as nearly continuously as possible and peroral drainage of the exudate is thus accomplished through the combined agencies of the tussive squeeze, ciliary drainage and the bechic blast.[3] The exudate is then expectorated The inverted position is maintained for a minimum of three minutes regardless of productivity This procedure is carried out at least twice daily, preferably on arising and retiring Coughing during the interval between drainage procedures is the signal that insufficient evacuation of the bronchial passages has been accomplished, and the frequency of the drainage procedure is then increased

The clinical and autopsy evidence available indicates that sinusitis, tonsillitis and possibly dental abscess are highly important factors in the production and perpetuation of the inflammatory bronchial and peribronchial process resulting in paroxysmal dyspnea It seems probable that although such focal infections are extremely common they are productive of bronchial asthma only when constitutional thymico lymphatic stigmata are present

Although it is possible by the above procedure to prevent asthmatic attacks where active infectious foci are present, total and permanent quiescence of the bronchial and peribronchial inflammation will occur only after ablation of these foci Under this treatment regime the laboratory and physical signs of bronchial asthma disappear Some of our patients have been asymptomatic for four years without treatment

Our series consists of a group of severe and recalcitrant cases ranging in age from six to seventy five years Strict adherence to the regime has not yet failed to keep our patients free from asthmatic attacks

Further studies are in progress regarding other factors which appear important in the provocation of the asthmatic attack and in the perpetuation of the disease process

NOEL F SHAMBAUGH[4]
SAM M ALTER

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2 Ian G Macdonald, *Annals of Internal Medicine*, vi 253, 1932

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SCIENCE

VOL 81 FRIDAY, MARCH 1, 1935 No 2096

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa Garrison N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

WHAT TO BELIEVE ABOUT COSMIC RAYS[1]

By Dr ROBERT A MILLIKAN

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IT is almost inevitable that any new field in which there are many workers should appear to the public and even to many of the workers themselves to be in a state of hopeless confusion This is because the individual workers, unrestrained in a new field by a body of established fact, tend to set up hypotheses that seem to fit their particular experiments or their particular theories and are themselves ignorant of, or at least incredulous about, the findings of others, so that the public soon loses itself in a maze of incompletely understood and apparently contradictory statements and opinions, and knows not whom or what to believe This situation is not improved by the existence of the daily newspaper, which, as its very name implies, is under a greater pressure to find for its pages something that is new than something that is true The truth is illusive, as Pilate long ago observed, and it cannot possibly be determined in time for the three o'clock edition If the present craze for the new regardless of the true, in art, science, society and government, goes much further the remedy may be found in the prospect that a nugget of sober uncolored truth may become the most exciting news there is just because of its rarity I venture the prediction that our present age, because of its craze for the new regardless of the true, will be looked back upon by our children's children with more amazement and ridicule than we ourselves feel because of the credulity of the middle ages or the smugness and hypocrisy of the Victorian age

In talking therefore, as I am asked to do to day, to teachers who seek to know what to pass on to their pupils in order to instruct and develop rather than to excite and mislead them, I propose to stick closely

[1] Address on the occasion of a special conference of the Committee on the Place of Science in Education, American Association for the Advancement of Science, Pittsburgh, December 29, 1934

to the results upon which there is to day large agreement among the most informed and competent workers and definitely to raise a red flag whenever I come down from the bench and begin to act as an advocate or even as a propounder of unestablished opinions

But when does an opinion become established? In physics when nine tenths of the competent and informed workers in the field are in agreement upon it I say nine tenths because I have lived long enough to discover that no matter how simple the problem or how inevitable the conclusion there will always be a small percentage of people who will vote no and that for no reason whatever except that they are built that way Here one has left the field of physics and entered the domain of psychology or perhaps pathology But as I propose to deal with physics to day rather than with either psychology or pathology I am going to define a practical, working knowledge in physics as that which gets the votes of nine tenths of a competent jury Parenthetically, you will have noticed that I am quite safe in that definition since I have not specified who is to determine the competence,' and have therefore left room for the advocates of authority and omniscience still to stay in the party With that working formula to start with, let us get down to articles 1, 2, 3, etc, of the platform

ARTICLE 1 What are we to believe about the penetrating power of the cosmic rays?

Here we can talk fact, which, up to a certain limit, nobody, so far as I know, will deny Indeed it was penetrating power alone that led to the discovery of the cosmic rays Up to 1910 the most general penetrating radiations known of any sort whatever, were the gamma rays resulting from the radioactive disintegration of uranium and thorium elements found scattered everywhere in small amounts throughout the earth s crust The most penetrating of these gamma rays—those from thorium C double prime—were known to be able to pass through a meter and a half of water or 16 cm (about 6 inches) of lead before being reduced to a half per cent, or one two hundredth part, of their initial strength These rays were known too, to have an energy of 2 6 million electron volts No one prior to 1910 had known of or even seriously suggested the existence of any more penetrating radiations Such rays given off in the earth's crust were known to be able to make their effect weakly detectable about a kilometer above the earth's surface The simplest way of detecting them was through measuring their well known power of discharging electroscopes When therefore the Swiss physicist Gockel in 1910 took up an electroscope in a balloon to a height of 4 kilometers and found it discharging there even faster than at the surface he had not indeed yet discovered a radiation more penetrating than the gamma rays of thorium, but he had proved definitely that there were other radiations coming in from above in addition to those coming from radioactive substance in the earth's crust Otherwise stated, he had discovered that the discharging effects observed in his electroscope at a height of 4 kilometers did not arise from these radioactive materials in the earth but from some other cause But the only other possible causes even of the penetrating rays found at the earth s surface had been discussed at length in preceding years and discarded in favor of radioactive materials in the earth s crust They were (1) radioactive materials distributed in the upper atmosphere which would presumably have a low penetrating power, like gamma rays, or (2) radiations coming in from outside the atmosphere, which would of necessity contain rays of a high penetrating power since they would have to get through the earth s atmosphere in order to be felt at the surface These two causes were both advanced again by Hess the next year, after he had repeated Gockel s experiments, risen to higher altitudes and found the discharging effects continuing to increase with increasing altitude He favored the second cause, but with correct scientific judgment presented both possibilities, since no measurements on penetrating power had yet been made

Kolhorster in the next years (1912 14) did commendably precise work of the same kind rising to 9 kilometers and finding the electroscope discharging effects continuously rising and reaching a value some 6 or 8 times that found at sea level Nothing further of importance happened until 1922, when Millikan and Bowen first sent electroscopes into the stratosphere (altitude 15 5 kilometers) and obtained electroscope discharge rates that did not keep rising exponentially in the regions above those reached by Kolhorster as they expected them to do if the rays came in from outside Up to this time no one had made any direct measurements of penetrating power such as could alone differentiate between these two hypothetical causes and determine unambiguously whether or not rays of a higher order of penetrating power than gamma rays existed

In the years 1922–25 that question was definitely and finally settled by experiments made in Europe by Kolhorster and in America by Millikan, Otis and Cameron Kolhorster took electroscope discharge rates above and beneath shallow bodies of water and also above and in cracks below alpine glaciers and computed from these observations penetrating powers of the order of ten times those of gamma rays, though the effects of local rays from the soil were hard to eliminate and left uncertainties in the minds of some critics Millikan and Cameron in America analyzed the waters of snow fed lakes and thus completely elim

inated the possibility of local effects, and brought to light unambiguously the existence of rays of at least 18 times the penetrating power of gamma rays In succeeding summers by the same method and with greater accuracy they brought to light rays coming in from above the lake and penetrating with certainty down to a depth of 300 feet or about 100 meters without being reduced to as small a fraction of their surface value as the Thorium C rays were found to be at a depth of 1 5 meters, in other words, they found without question rays more than 50 times as penetrating as the gamma rays

Regener has followed the same kind of measurements in Lake Constance in Switzerland down some two and a half times as far as did Millikan and Cameron in Gem Lake, Calif, with results in substantial agreement with theirs as far as they went down

The existence, then, of a radiation coming in from above and having a penetrating power varying from six to a hundred times that of gamma rays you may definitely believe in No one, so far as I know, any longer doubts that much nor has doubted substantially that since 1925

The existence of rays of any kind of such enormous penetrating power is naturally exciting to the imagination

But here goes up the red flag! You need not as yet believe claims to much higher penetrating powers For when one is trying to measure the minute high penetrating tail of the cosmic ray depth ionization curve caution is the word Whenever the cosmic ray ionization which it is sought to measure sinks below the zero of the instrument *i e*, below the discharge rate due to internal wall effects and the external radioactive contamination of the surroundings, do not let the sale be consummated until you have got concurring reports from different, independent and dependable appraisers My own rule for under water work has been to doubt the dependability of discharge rates less than a thirtieth the discharge rate at the surface Under especially good conditions this might be stretched to a hundredth, but beyond that do not report to your pupils any conclusions as even probably until two or three independent observers get into agreement upon them It is just too bad to drag an interested public through all our mistakes as we cosmic ray experimenters have done in numerous instances during the past four years

So much about what you may believe about the existence of a new and an enormously penetrating radiation

ARTICLE 2 What may we believe about the place of origin of the cosmic rays?

Here, too, I think I can get my jury into agreement if the word "place" is not too narrowly understood, though it has been a hard job to convince it From statements widely circulated in the papers, I could not have expected agreement two years ago Now, however, I think I may say that you may believe that the cosmic rays come from beyond the Milky Way Some meticulous person may think that a bit roomy to be properly described by the word place

Cameron and I convinced ourselves of the correctness of this view in 1925 when we proved by our observations in Muir Lake (altitude 11,800 feet) and Arrowhead Lake (altitude 5,100 feet) that the atmosphere between these two levels acted merely as a blanket and had no effect as a new source of radiation, for we thought that this combined with the enormous penetrating power of the rays, made it practically certain that they did not originate anywhere in our atmosphere As I indicated above both Hess and Kolhorster had favored that view before us, but neither their suggestions nor our arguments seemed to convince the jury, for at the Volta centenary, held at Como, Italy, in 1927, one of the most distinguished and competent of living physicists took the platform after my address and said that although our work had proved indubitably the enormous penetrating power of the cosmic rays and had also shown that these rays did not originate in the lower atmosphere he still preferred to think that they originated in the remoter upper atmosphere I then advanced the further evidence that we had tested very carefully the independence of the intensity of the rays upon the presence of the sun and felt that it was scarcely thinkable that any events could be taking place in the outer regions of our atmosphere of such a nature as to produce rays of the observed penetrating power that would not also be taking place in the remoter regions of the sun s atmosphere, and if this were true we should detect a very large change in cosmic ray intensity as the earth turned her face toward the sun To this argument there was no answer and I was later informed by the same authority that he regarded it as quite convincing But still further evidence has appeared It consists in the findings made by Clay of Amsterdam as early as 1928 and by a whole group of us since the beginning of 1932 of the influence of the earth s magnetic field on the particle component at sea level of the incoming rays This shows that these particles must have come in from a distance of at least four or five thousand miles since the earth s magnetic field, extending as it does out to a distance of ten thousand miles and more could have no such effect as is observed upon these particles if they originated even in the upper regions of our atmosphere, which extends in appreciable density only for a distance of a few hundred miles at most

All this evidence taken together has, I think, by this

time convinced the jury that the rays at least do not originate in our upper atmosphere Even within two years, however, the confusion of thinking that has existed in this field is brought into evidence by newspaper comments and even technical paper comments, to the effect that somebody thinks these rays originate in the stratosphere, said stratosphere having apparently recently become to the public a solvent of all riddles—a kind of cosmic Houdini in the performance of the miraculous

If, then, the upper atmosphere is excluded as a place of origin, then lack of any significant direct influence of the sun and the Milky Way clearly places the place of origin "beyond the Milky Way" This argument is quite independent of whether the sun may or may not be ultimately shown to exert some minute direct influence Theoretically it might do this through the effect of secondaries stimulated in its atmosphere by primary cosmic rays that could be assumed to traverse space uniformly in all directions The only significant consideration for our purpose is that if the sun, or other stars like it, were the original source of the cosmic rays, then on account of its closeness to us it should cause an enormous difference to appear between the daytime and the night time intensities, which it in fact does not do The indirect influence of the sun arising from the heating effects in the earth's atmosphere is well known and universally accepted These, combined with the fluctuations in the rays themselves, have apparently masked any direct influences if they exist This is a matter on which there is as yet no complete agreement, but it is not important for the action of the jury on the question, Do the cosmic rays come to us from beyond the Milky Way? I think that the jury will answer, 'You may believe that they do"

ARTICLE 3 What may we believe about the energies of the cosmic ray particles?

Here again the answer is now very definite so far as it goes Up to 1931 it was not at all definite Indeed most of the errors that cosmic ray workers like Millikan, Regener, Jeans and others have themselves made in the years preceding 1931 and passed on in double measure to the public were due to the assumption that one might compute the energies of the cosmic rays from their penetrating powers with the aid of the earlier formulas relating to energy and penetration

As soon as in the fall of 1931 the workers at the California Institute got into actual use our apparatus for directly measuring these energies the uselessness of these earlier formulae, like that of Klein Nishina, became at once apparent For the first thing that we clearly demonstrated was that the most significant factor in the absorption of cosmic rays is the nucleus, while all absorption formulas that had appeared up to that time had ignored it entirely This result followed from the fact that both positive and negative particles appeared, and in approximately equal numbers, in the Wilson cloud chamber photographs taken by Dr Anderson, and it had been known for 20 years that positive particles could come only from nuclear encounters

Do not then believe anything now as to cosmic rays that depends for its credentials upon any theoretical absorption formulae whatever Some of the newer formulae that try to handle nuclear absorption may be correct, but not one of them has yet established its credentials in the range of cosmic ray energies

These Anderson measurements have, however, extended the range of directly measured particle-energies from 15 million electron volts, the highest attained up to 1931, up to 6,000 million electron volts, and you may therefore now believe with entire assurance that charged particles of such energies as these—energies undreamed of five years ago—actually exist Not only that, but the existence of both a latitude and a longitude effect proves to the satisfaction of the jury that some of these particle energies reach up to an even higher figure, namely, up to 10 billion electron volts and more The existence then of charged particle energies of at least 6 billion electron volts and probably of more than 10 billion electron volts is one of the most amazing facts of modern physics

ARTICLE 4 What are we to believe about the kind of processes that give rise to charged particle bullets of such stupendous energy?

Here goes up the red flag! You may not believe anything as yet about that! The atom building processes which I earlier thought were adequate to account for the then estimated energies, and which might still be adequate from a purely energetic standpoint to be responsible for the less energetic and more numerous of the cosmic rays, are certainly completely inadequate to account for the highest of these observed energies There are no processes whatever, that we can have any sort of assurance are taking place, that can be called upon to produce such energies as the highest of those observed The atom-building processes can not reach higher than to about 2 billion electron volts Of course there are processes that might be taking place, but remember that everything that anybody says about that subject is purely speculative, legitimately speculative if you will, but do not confuse it with anything that you can now believe!

ARTICLE 5 What may we believe about the nature of the energy bullets with which the super-bandits of the universe are shooting up our earth and everything

upon it? Are they photon bullets or are they charged particle bullets?

This last question can be partially answered with definiteness, but only partially. Since photons can only ionize the matter through which they pass by knocking charged particles out of atoms and since the cosmic rays must have come through some matter before entering the earth's atmosphere, the entering cosmic rays must in any case have some of these charged particles as constituents. There has never been any doubt about that in anybody's mind so far as I know.

Further, the existence of an effect of the earth's magnetic field upon the intensity of the cosmic ray—and this is agreed upon by everybody—proves directly that there are these incoming particles. This much, then, you may surely believe. The only question that there has ever been for experiment to determine is whether the incoming rays are all particles or whether they are a mixture of photons and charged particles. Upon this question the jury is still working. It has not yet got into agreement. I expect it to hand in its verdict within a twelvemonth. But for the present believe nothing.

ARTICLE 6. What are we to believe about the effect upon the nucleus of an atom of being hit by cosmic ray shots of the foregoing energy?

Here the results are definite. You may believe that both positive and negative electrons result from that encounter. It was through actually observing in a Wilson cloud chamber such encounters that Anderson made the discovery of the existence of the free positive electron—a discovery that seems to me the most fundamental one that has been made since the discovery of the quantum by Planck in 1900—fundamental because it has forced us to relinquish the beautifully simple concept we had heretofore been content with of a universe built up of but two primordial elements, positive and negative unit charges, the former called the proton because the positive unit charge was thought by its very nature to be about 2,000 times heavier than the negative unit and therefore to carry all save 1/2,000 of the mass of matter. The discovery of the existence of the free positive electron with a mass the same as that of the free negative electron destroys that picture. We need now at least 3 fundamental elements, namely, either (1) positive and negative electrons and neutrons or (2) positive and negative electrons and protons. The discovery, during the preceding year, of the neutron forced no such change in our thinking, for according to its discoverers the neutron was then merely a proton and a negative electron in close association. As many as 15 positive electrons and 7 negative electrons have been actually seen to emerge from a photon encounter with a nucleus of lead. Whether those electrons are all knocked out of the nucleus or are created as positron negatron pairs by the encounter we do not yet know. But that both free positive and free negative electrons result from the encounter of a cosmic ray photon with a nucleus there can be no doubt.

ARTICLE 7. What are we to believe about the final fate of these newly found positrons?

They are certainly created, or released, in great numbers by photon encounters of sufficient energy with the nuclei of atoms, probably also, though very much less frequently, by electron encounters with nuclei, and they certainly quickly disappear somehow—since we do not find them in our ordinary studies of either metallic or gaseous conduction. They are thrown out into a world that swarms with extra-nuclear negative electrons, and I think the jury will agree that as soon as their energy is spent they rush together under the influence of the mutual attraction of positive for negative, and the pair thus passes out of existence as electrons, their joint mass, however, being transformed in accordance with Einstein's equation, into radiant energy in the form of two oppositely directed photons each of an energy value of half a million volts.

These are called annihilation rays and have been many times directly observed. They were first brought to light by Chao at the Norman Bridge Laboratory in 1930 and described by him as isotropically distributed, half million volt rays resulting from the impact of the 2.6 million volt gamma rays from Thorium C'' upon the nuclei of both lead and aluminum. Chao, however, did not know that these were annihilation rays. This was first proved very beautifully by Jean Thibaud of Paris in 1933.

ARTICLE 8. In addition to the foregoing you may of course believe any direct experimental findings from which the personal equation and the judgment of the observer have been entirely eliminated. Many observers could show you such, and I wish to close this very brief statement of some of the articles that you may believe because of the vote of a jury by showing you a group of photographs that tell their own story quite independently of any interpretation which either I or the jury have brought in.

Through most of these photographs[2] you will be the direct witness of the terrible bombardment to which you and everything on this earth of ours is being continuously subjected by some unseen, universally distributed but largely unknown cosmic agency.

[2] These photographs are all found in a book issued in January, 1935, by the University of Chicago Press entitled, "Electrons + and −, Protons, Photons, Neutrons and Cosmic Rays."

CERTAIN ASPECTS OF GEOLOGIC CLASSIFICATIONS AND CORRELATIONS.[1] II

By Professor ROLLIN T CHAMBERLIN
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In the tripartite division of the old Carboniferous into the *Mississippian Pennsylvanian* and Permian systems the first division between the Mississippian and Pennsylvanian is seemingly based on sound grounds, but the present separation of the Permian from the Pennsylvanian has no such good basis If we look to diastrophism as the ultimate basis for classification we naturally turn to the Asturian phase of the Hercynian revolution Diastrophically this was the most pronounced of the several important manifestations of earth unrest during Pennsylvanian and Permian times Was it also the most significant from the standpoint of its consequences—stratigraphic climatic and biologic? This is the vital question, but one which owing to its complexity and the lack of sufficient data we are perhaps not yet ready to answer satisfactorily

The Asturian orogeny broke out between the Westphalian and Stephanian of Western Europe or the Moscovian and Uralian of Eastern Europe A marked stratigraphic break characterizes much of Europe Where the corresponding formations are well displayed in Eastern Asia a similar important gap in the stratigraphic column is likewise manifest In China, the equivalent of the Uralian, separated from the underlying Middle Carboniferous by a pronounced unconformity possesses a very different fauna which however, is closely linked with the overlying Artinskian classified as Permian In India and South Africa, the Talchir and Dwyka tillites at the base of the Permo Carboniferous sequence both rest upon very much older rocks, so that the time gaps in these regions are very much longer and definite knowledge of whatever diastrophic manifestations may have preceded the glaciation is wanting More certain dating of these tillites is greatly needed, but the long time represented by the unconformities beneath is in itself of some significance On the other hand, the history of Texas and adjoining region has been different A relatively complete record of the Pennsylvanian and Permian is here the notable feature No dominating conspicuous break is found within the existing Pennsylvanian Permian stratigraphic column where those formations are best represented, though Hercynian deformation strongly affected other belts Consequently reasons have been advanced in this country *for combining the Pennsylvanian and Permian into* a single system But European, Asiatic and Southern Hemisphere history was seemingly more significant at this time than North American

As means of classification and correlation we have the orogenic movements, the regressions of the sea, *the glaciation and the faunas and floras* The practical question arises How closely synchronous were the orogenic movements and the regression of the seas in the most typical regions of the globe? Our chief method of determination is by the use of fossils We rely principally upon them for dating formations and events *Where diastrophic episodes do not match* closely in distant lands according to fossil testimony, we are prone to assume that these physical events were somewhat scattered in time Is this conclusion, however, necessarily true? May not the other alternative perhaps be true in many cases? May not the diastrophism have *been relatively short lived and more* or less synchronous in the broader sense, while the seeming discrepancy in time lies principally in the fossil interpretations? Are the fossils *always* a better means of age determination and correlation than major diastrophic movements?

Let us consider fossil criteria for a moment Age determination and correlations can be based upon the first appearance of certain forms of life which are taken to be of diagnostic significance, or they can be based upon the last stand of old forms, or upon the presence of certain short lived, highly characteristic types or assemblages If we utilize the first appearance of new forms, we face the problem of their migration from distant regions So far as present information may be trusted, slowness of migration has apparently often been the case This may have been a matter of slow travel, or of delay until the removal of barriers allowed the necessary spreading into the areas considered, or until slow physical changes in a given region made it a fit habitat for invasion by the forms of life in question In many cases, the time required for the accomplishment of these things may have been very considerable, and the initial appearance of critical forms in two distant regions may have been at very different times Furthermore, in addition to the true time difference, the discrepancy may appear still greater because of the well known imperfections of our very fragmentary fossil records The

[1] Address of the vice president and chairman of the section on Geology and Geography, American Association for the Advancement of Science, Pittsburgh December 31, 1934

earliest of fossil finds may not represent the first invaders

Favorable or unfavorable environmental conditions are very important in determining whether a given life assemblage will, or will not, inhabit two different areas at the same time So also, hostile conditions have often caused the disappearance of certain types from some areas, while they linger long after in other areas of more genial climate, fewer enemies or other advantages

When these important factors shall have been more fully worked out and better understood, and when our present patchy information shall have been greatly extended, as it will be in time, our paleontologic correlations will be much more reliable than they are to day Every little while the known range of a species or genus is extended rather surprisingly Not infrequently two species, supposed to exist only in beds separated by many hundreds of feet of strata are found together in the same hand specimen

This is not an attempt to disparage paleontologic correlations, for their great value is universally recognized but we must face the facts and maintain a proper open minded reserve It may well be that the major diastrophic movements were more nearly synchronous in different portions of the earth than some present fossil correlations would lead us to believe That possibility must be kept in mind while awaiting fuller knowledge

Likewise of importance in our problem is a more certain timing than we now have of the onset and main stages of the glaciation in Australia, South Africa, India and South America The thicknesses of late Paleozoic glacial drift in these widely separated regions were so much greater than those of the Pleistocene glacial drift of Europe and North America, and the glaciers reached such incredibly low latitudes, that it seems reasonable to infer a general refrigeration of the earth's climate during the several stages of glaciation The only alternative now apparent is to assume that the strongly glaciated areas were at those times located in the South Polar region—a view not favored for various reasons, not the least of which is the difficulty of explaining, on this hypothesis, the warm interglacial times between the glacial stages If we believe in an underlying general cooling of the earth's surface and atmosphere, with special conditions of precipitation, atmospheric and ocean currents, etc, determining the loci of glacier development, the climatic factors must not only have been of great importance in leading to radical biologic changes, but the times of glaciation, ordinarily relatively short in duration, should have been roughly correlative in the different continents

If we accept this view, another question confronts us How closely was the glaciation related in time to the diastrophism, particularly the Asturian disturbance? It seems now that the first of these late Paleozoic glacial stages appeared approximately at the close of the Mississippian which was characterized by the Culmide diastrophism David and Sussmilch locate the second glacial stage of New South Wales high up in the thick Kutting series, which they call Middle Carboniferous and the third or Lochinvar glaciation at the base of the Kamilaroi (Permo Carboniferous) system According to their sections, the deposits of the second glaciation lie directly below those of the third (Lochinvar, Bacchus Marsh, Inman Valley) glaciation though there is a break in the sequence and a marked floral change between them At some time within this interval was the Asturian orogeny The fourth and fifth Australian glacial stages occurred much later in the Permian

In India, the Talchir tillite has usually been placed after the Middle Carboniferous In harmony with this Grabau held in 1933 that the Talchir glacial beds of the Salt Range belong to the time of the Asturian folding and succeeding erosion Du Toit believes that the Dwyka glaciation of South Africa, whose deposits he regards as unmistakably equivalent to the Sierra de la Ventana tillite of Argentina, began at the end of the Lower Carboniferous and terminated not later than the close of the Upper Carboniferous His 1933 view was that the main Gondwana glaciation reached its maximum during the middle of the Upper Carboniferous (Westphalian Moscovian) and that the only true Permian occurrences seem to be the minor ones of New South Wales and probably Bolivia

From the writings of these authorities one would judge that an important Culmide glaciation occurred at the close of the Mississippian and another and more pronounced glaciation about the time of the Asturian orogeny Schuchert, on the other hand, while in agreement on the Culmide glaciation, is strongly of the opinion that the Dwyka Talchir Lochinvar glaciation occurred long after the Asturian orogeny, in early Artinskian or early Middle Permian according to his classification In this difference of opinion, we see the present status of the Permo Carboniferous glacial problem

Whether the Asturian phase of the Hercynian revolution should properly be raised to the importance of a division marker between geologic periods is therefore less a question for immediate decision than a working proposition to be tested with each new acquisition of relevant facts Nevertheless, a movement toward utilizing this Asturian break between the Westphalian and Stephanian or Moscovian and Uralian, as the division between the Pennsylvanian and the Permian is already apparent As a result of

his recent wide studies in China, Grabau now definitely ends the Pennsylvanian with the Moscovian and starts the Permian with the Uralian Schuchert, in his latest writing on the Permian, does likewise, though maintaining that the pronounced glaciation followed long after the beginning of the Permian

If we entertain tentatively the proposition to begin the Permian with the Uralian, following the Asturian orogeny, the close of the Permian likewise merits consideration in rounding out the problem of that period Lack of time, however, will allow only brief consideration of one possibility The Saalian orogeny, after deposition of the Lower Rothliegende, caused an important break in the European stratigraphic succession and was followed by a flora of more Mesozoic aspect As the authorities participating in the symposium before the British Association have considered this a more significant break than that between the present Permian and the Triassic, it may be that the most logical termination of a redefined Permian period is at the Saalian deformative episode In the Eastern United States, the Appalachian revolution occurred after the Dunkard (Lower Rothliegende), though it is not yet certain just how soon after the Dunkard it actually took place Should the Appalachian revolution prove to be equivalent to the Saalian deformation in Europe, this would be strong additional reason for placing a division between periods at that time Therefore, as a working hypothesis to be given careful testing, we have the proposition that the Pennsylvanian end with the Asturian orogeny, that the Permian comprise the time from that deformation to the close of the Saalian disturbance (or Appalachian revolution), and that what remains of the present Permian after that be included in the Triassic, to which it is closely related

This proposition, so briefly and inadequately treated here, leads to the final, still larger question Where is the boundary between the Paleozoic and the Mesozoic between ancient life and medieval life, most appropriately placed? Drawing it at the Saalian break is one alternative In this case the Permian, between the Asturian and Saalian beats of the geologic rhythm, would constitute a transitional period completing the Paleozoic General conservatism may militate against any more radical departure from our present classification than this But, when everything has been considered, does such a step go far enough?

One of the principles of the general philosophy here followed is to go back to causes and beginnings If we are correct in seeking the initiation of the newer order in the Asturian phase of the Hercynian revolution, that should seemingly have strongest claim as the natural starting point of the new era. On this basis, the Permian, with the beginning and early stages of the newer order of things, would belong to the Mesozoic

The Mesozoic is the "Age of Reptiles" Outstanding in importance in that era, this great class overshadows all other animal groups Already in the Permian the reptiles were strongly developed and considerably deployed From the Pennsylvanian, however, they have not been reported in any great abundance Very recently Professor Romer has been exploring the Upper Cisco beds of Texas with confident expectation of finding significant reptiles in those strata which have ordinarily been classed as Pennsylvanian As the Upper Cisco, however, is correlated with the Uralian, these beds according to the classification here under consideration would belong to the early Permian So far as we can judge at present, the first rise of the reptiles to power was not far removed in time from the Asturian orogeny, following which came their relatively rapid and very great development Including, therefore, the post Asturian Permian in the Mesozoic would make that era, in the truest sense of the expression, the "Age of Reptiles"

The keynote of this address may be taken to be an encouragement of efforts to bring greater harmony into our general picture of earth history There is nothing new in the motive, nor is it taking a new tack to urge the cosmopolitan point of view against the provincial point of view What has been presented merely reemphasizes some of the underlying philosophical considerations whose application is believed to be broader and of more general import than regional peculiarities and local details Even so, perhaps too much uniformity is expected of so large a sphere as our earth, perhaps we shall find that there has been too much local variation in the behavior of different portions of its surface to allow completely satisfactory coordination of all into a single standard history Possibly practical considerations will force us to recognize that a given geologic period, as best delimited in a certain area, actually began there earlier than it did in some other particular area, according to the most useful classification in that area This address ends in the year 1934, Australia and Eastern Asia are already in the year 1935 We must take nature as it is In any case, however, it is best to assume the attitude that geologic history can be treated satisfactorily on a world basis, and to proceed on that assumption until it shall be definitely and finally proved that Mother Earth has not shown sufficient system and order in her doings to give us a basis for a good universal classification

OBITUARY

COLLIER COBB

COLLIER COBB, professor of geology at the University of North Carolina for forty two years and head of the department of geology for thirty nine years died at Chapel Hill on November 28, 1934, after an illness of more than a year Professor Cobb was one of the pioneers in North Carolina geology and the first to become head of the department of geology Previous to that time geology had been chiefly taught along with chemistry or zoology by the professor, who was also state geologist, beginning with Denison Olmsted in 1824 (the first state geologist in the United States), and ending with Professor J A Holmes, who later resigned as state geologist to organize and become the first head of the U S Bureau of Mines

After two years study at Wake Forest College and one year at the University of North Carolina, Professor Cobb entered Harvard University, where he took his A B and M A degrees For two years before going to the University of North Carolina he served as instructor in the Massachusetts Institute of Technology

Professor Cobb has a notable record as an enthusiastic and inspiring teacher He believed that the spirit of the subject was more important than the letter, and with this same appreciation many of his students have gone out into positions of responsibility and honor

Professor Cobb was a native of North Carolina and was noted for his devotion to his state and its institutions, but this fact did not in any way limit his keen interest in travel and in world affairs and he was nearly as well known abroad as in the United States His striking personality, keen intellect and remarkable memory, coupled with a wealth of rare anecdotes, made him a central figure in any group

In his studies Professor Cobb covered a wide field of thought, although his greatest interest was in the work of the wind in desert and shore areas as is indicated by 'Where the Wind Does the Work," "Lands and Dunes of Gascony" and the "Loess Deposits of China" Because of his travel and great interest in peoples and customs he will, perhaps, be best remembered in the scientific world as a human geographer and as a student of shore-lines and shore line processes Most of his scientific publications deal with one or the other of these two subjects

The early intellectual development of Professor Cobb was remarkable At the age of nine years he began the publication of *The Home Journal* in Shelby, N C He was editor, illustrator, printer and distributor Many of the illustrations were drawn on wood blocks for printing and showed marked artistic ability

Professor Cobb was such a keen observer of people, languages and customs and so well acquainted with different types of people that he was usually able to tell from what country and frequently from what province a foreigner had come When meeting a new class for the first time it was his custom as students responded to the roll call to tell them the state they came from and the county, if from North Carolina, and frequently much about their people

Professor Cobb was a fellow of the Geological Society of America and a member of many societies, including the American Association for the Advancement of Science, the Association of American Geographers, the Boston Society of Natural History, the American Institute of Mining and Metallurgical Engineers, the Seismological Society of America, the Elisha Mitchell Scientific Society, the North Carolina Academy of Science and Sigma Xi

Professor Cobb resigned as head of the department of geology in 1932 and began the preparation of a book of reminiscences It is very unfortunate that he did not live to finish this work, which held so much of interest for many people here and abroad

WM F PROUTY

THOMAS HUSTON MACBRIDE

IN the death of Thomas Huston Macbride society lost a useful citizen, university life lost an inspiring leader, and science lost an able and devoted worker He sold the idea of beauty to the people of Iowa, showing them how the ugly could be transformed to the beautiful A striking example of this was his successful efforts in beautifying public squares, parks and cemeteries in communities throughout the state He saw beauty, actual or potential, everywhere Whether in the prairies, streams, lakes and groves of Iowa, the desert regions of the Southwest, or the mountains, shores and evergreen forests of the Northwest he always saw beauty as he went about his scientific work, and aroused enthusiasm for preserving this beauty and for restoring it where it had been destroyed He saw beauty in the cabins and sod houses of the Iowa pioneers

In his academic life his high personal ideals, his kindness and the beauty of his teaching had effects on his colleagues and his students which will last a long time To his students he taught more than botany he taught ideals of life and appreciation of beauty Many took his courses, not because they wanted botany, but because they wanted to sit in the presence of a great personality

Born at Rogersville, Tenn, on July 31, 1848, the son of a minister, he went with the family by wagon

to Iowa in 1854. There the family lived on the prairie and Thomas, the oldest of the children, worked all week for neighbors and came home on Sunday for religious worship and training He was at Monmouth College from 1865 to 1869, studying mainly Latin, Greek, Hebrew, French and Bible He took only one year of science (botany and physiology) He received the following degrees—A B, Monmouth, 1869, A M, 1873 LL D, 1914, Ph D, Lennox College, 1895, LL D, Coe College, 1915 In 1891 he studied in Strasburger's laboratory at the University of Bonn, and also visited Pasteur's laboratory at the Institute in Paris

He was professor of mathematics and modern languages at Lennox College (Hopkinton, Iowa) from 1870 to 1878 At the State University of Iowa he was assistant professor of natural science from 1878 to 1884, professor of botany from 1884 to 1914, and president from 1914 to 1916 He was president emeritus of this university from 1916 to the time of his death He lived in Seattle from 1924 to the time of his death on March 27, 1934 For several years previous to 1924 he had divided his time between Iowa City and Seattle

In science his contributions began with his trips over the prairies of Iowa on foot and by team with his lifelong friend, Thomas Calvin, for the study of geology and botany, and were continued in his trips to the southwestern and northwestern United States and also to Mexico and Europe Outstanding accomplishments of his scientific career were his field collection of Cycads, his special study of slime moulds, and his establishment of the Lakeside Laboratory at Lake Okoboji, Iowa. In June, 1934, the University of Iowa commemorated his service there by naming the natural science building Macbride Hall

Among his professional publications are numerous chapters in the Reports of the Iowa Geological Survey, papers in the Proceedings of the Iowa Academy of Science, his "Text-book of Botany," the three editions of his "North American Slime-Moulds," and "The Myxomycetes", a descriptive "List of the Known Species with Special Reference to those Occurring in North America" The last, in collaboration with Dr G W Martin, was published after Dr Macbride's death Other tangible results of his work are his collections of plants distributed to various herbaria, the fossil Cycads which he discovered in the Black Hills of the Dakotas and distributed to the British Museum and other institutions, and the teaching and research facilities available at the Macbride Lakeside Laboratory on the shore of Lake Okoboji in northern Iowa

Many of his public addresses were published, and he wrote, by request, many newspaper articles dealing with the state of Iowa and its university Two volumes of his addresses (1916 and 1925) were published under the title "On the Campus" His sympathetic interpretation of the life and ideals of the early pioneers of Iowa found expression in his volume 'In Cabins and Sod Houses" (1928) He also published notes on his experiences at Bonn and various travel notes

It was my privilege to know Dr Macbride over a long period of years, and I owe much to the influence of his charming personality, the breadth of his scholarship, his love of nature, his skilful teaching and his enthusiasm for research It was he who, in my freshman year, first gave me an insight into the field of botanical science, and it was he who, in the years when he was growing old beautifully in Seattle, was still a valued friend and counselor

GEO B RIGG

SCIENTIFIC EVENTS

TELEVISION IN GREAT BRITAIN

THE London *Times* reports that a television advisory committee has been appointed by the postmaster general to cooperate with the British Broadcasting Company in the inauguration of public television service

The question of a suitable site for the London station is an important one To ensure a sufficiently large area of service it is essential that the sending aerial of the station should be on an elevated site, since, in the case of the ultra short waves to be used, it is necessary to have a substantially uninterrupted path between the sender and receiver It is also desirable that the sending station should be in the center of a densely populated area.

One of the best sites is at the top of the Crystal Palace Tower, which has been used since June, 1934, for experimental and developmental work, and is now fitted with the required studios and laboratories. Vision signals are now sent out on a wave length of 7 meters, while the accompanying sound is radiated on 8 5 meters, and demonstrations of satisfactory reception of both vision and sound have been given at places as far as twenty five miles from the Crystal Palace

Two new Baird home televisors have been demonstrated on the Crystal Palace signals One model showed a brilliant black and white picture 8 inches by 6 inches in size, while the *de luxe* model gave a picture of 12 inches by 9 inches, suitable for an audience of thirty people

Baird Television, Inc, has also demonstrated the

transmission of scenes by the intermediate film process By means of it a talking film of an event is recorded and subsequently used for vision and sound transmission The developing, fixing and washing of the film are carried out so expeditiously that there is a delay of only 30 seconds between the film recording and the television transmission

The Marconi E M I Television Company, who, with Baird Television are to be invited to supply television senders for the new London station, have television receiving sets ready for the market, but point out that radio sound broadcasting will dominate the programs for many years and that television will not in any way interfere with the developments in radio sound broadcasting with its ever increasing entertainment value

EXHIBIT OF MINERALS AT THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

FIFTY minerals, prepared by Miss Mary Allison Reed, of the staff of the Academy of Natural Sciences of Philadelphia, have been placed on exhibition in the mineral hall of the natural history museum

The minerals, which are displayed on a black felt covered panel around a road map which shows the source of the specimens, have been gathered in quarries and mines near Philadelphia and from the rocks exposed along the Wissahickon and nearby streams Ten localities, typical of those with similar underlying rocks but most prolific of their type, are represented in the collection

The localities and the minerals are as follows

(1) French Creek iron mines, 8 miles southwest of Pottstown pyrite, chalcopyrite, calcite, apophyllite, magnetite, byssolite
(2) Perkiomenville, Kibblehouse crushed stone quarries calcite, stilbite, chabazite, natrolite, heulandite, epidote, garnet.
(3) Wheatley lead and zinc mines, 2 miles south of Phoenixville quartz, calcite, ankerite, galena, sphalerite, fluorite, cerussite, anglesite
(4) Railroad cut west of Henderson Station (near Bridgeport) quartz crystals, limonite
(5) Soapstone quarries below Miquon (Lafayette) serpentine, chlorite, dolomite talc, hornblende, magnetite
(6) Rocks along Wissahickon, 500 feet north of Devil's Pool anthophyllite, cyanite, garnet, staurolite.
(7) Vanartsdalen's quarry, 2 miles north of Neshaminy Falls blue quartz, pyroxene, orthoclase, amphibole, wernerite, wollastonite, graphite, zircon, titanite, apatite, pyrrhotite
(8) Brinton's quarries, 3 miles south of West Chester serpentine, albite, magnesite, magnetite, asbestos, clinochlore, jefferisite.
(9) Rocks in creek and hillside of Mineral Hill, west of Ridley Creek (Media) serpentine, deweylite, sunstone, moonstone, amazonstone, chromite, enstatite, actinolite
(10) Leiper's quarry, Crum Creek near Swarthmore quartz, microcline (feldspar), muscovite and biotite (micas), beryl, tourmaline, garnet

AWARDS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

THE American Institute of Mining and Metallurgical Engineers held its annual meeting in New York on February 19 and 20 The Howe Memorial lecture was given by Earl C Smith, chief metallurgist of the Republic Iron and Steel Company, who discussed the effect of the application of petrography on the production of steel

An international symposium on geophysics included papers by Rudolph Krahmann and Leopold Reinecke, of Johannesburg, J G Sineriz, of the Spanish Geological Survey, and Howard I Smith, of the United States Geological Survey

Medals for distinguished work in mining and metallurgy were presented James MacNaughton, president and general manager of the Calumet and Hecla Consolidated Copper Company, received the William Lawrence Saunders Gold Medal for his work in the field of copper mining

The James Douglas Medal for distinguished achievement in non ferrous metallurgy was awarded to George C Stone, author of numerous papers on this subject and an authority on the extraction of zinc

The J E Johnson, Jr, Award was given to Francis M Rich, of the Republic Steel Corporation, Youngstown, Ohio, for his work in the development of blast furnace operation under conditions of slow blowing

Thomas Arthur Rickard, of Victoria, B C, Canada, received a certificate of honorary membership in recognition "of his outstanding achievement as a proponent and preceptor of advance standards in technical concept and writing, and his brilliant contributions to the literature of geology, mining and metallurgy, as editor, journalist and author"

Six men who have been members of the institute for fifty years received the insignia of the institute's Legion of Honor They were Arthur S Dwight, Arthur L. Walker, H L Hollis, L W McKay, C Snelling Robinson and H H Webb

Howard N Eavenson, retiring president of the institute, presided Dr Henry A Buehler, director of the Missouri State Bureau of Geology and Mines, was elected to succeed him Other officers elected were *Vice presidents*, John M Lovejoy and Paul D Merica, *directors*, Dr Charles K Leith, Edwin E Ellis, Wilber Judson, Wilfred Sykes and R M Roosevelt

THE HARVARD ARCHEOLOGICAL EXPEDITION TO VENEZUELA

DR. ALFRED V KIDDER, honorary curator of southwestern American archeology of the Peabody Museum of Archeology and Ethnology, Harvard University, has returned from Venezuela, where he directed the archeological researches of the expedition sent into the field by Harvard University Excavations were carried on at Los Tamarindos on the peninsula of La Cabrera, Lake Valencia, and also in the desert and Andean regions west of Lake Valencia

The *Boston Evening Transcript* reports that cultural remains were found in two distinct layers at Lake Valencia An early civilization was in evidence in stratified layers of sand and gravel which extended from three feet below the surface of the earth to a depth of twenty five feet or more, a succeeding civilization was discovered in the topsoil, or humus cap, three feet thick at the earth's surface Dr Kidder found practically no relation between the two civilizations, indicating possibly that the earlier civilization was wiped out by the inroads of a hostile tribe, and the pottery has so far yielded little evidence as to their identity The tribe originally holding the site may have been a branch of the great linguistic group of Indians named the Arawaks, whose occupancy probably began about A. D 1000 The invaders may have been a part of the linguistic group known as the Caribs, who possibly originated in the vicinity of the River Xingu, Brazil

The view that the Caribs drove the Arawaks out of this region is supported by an archeological opinion of long standing that two or three centuries before the Spanish conquest of the territory there was a large Carib migration to the north, reaching as far as the Greater Antilles and perhaps even to Florida Dr Kidder notes, however, that the picture is far from complete, since he found that as late as 1880 Indians in the Lake Valencia vicinity still spoke the Arawak dialect Whatever tribe held the Lake Valencia site at the time of the Spanish invasion, however, was completely wiped out

The earlier civilization was characterized by the practise of primary burial Bodies were buried immediately after death and left undisturbed Pottery vessels, some of coarse material roughly made, others of fine clay, polished and decorated, were found in the graves, as well as pipes, carefully and highly decorated These were of special interest because they seemed to have no relation to others found in the vicinity

The first culture appears to be totally unrelated to the later civilization on the same site Secondary burial was practised by the later inhabitants Bodies of the deceased were exposed, and the bones were rearranged in a particular manner in funeral urns of pottery These pottery vessels showed characteristics distinct from those of the earlier period, but similar in some respects to those found in Central America, Brazil and the Antilles

On a reconnaissance expedition through western Venezuela, Dr Kidder found further fragmentary evidence of the relationships between the Indian tribes of the second period, but none with those of the earlier period A rich archeological deposit was discovered in the Carache Valley, the sides of which, though heavily eroded, were covered with a mass of potsherds The people of this region practised primary burial Their pottery, hard, well fired and intricately decorated, showed them to be distinct from any civilization previously found Attempts at archeological research in Barquisimeto and near Merida gave few results, as little remained *in situ*, but a study of private collections in these vicinities showed a relation between the Andean culture and that of regions to the west

THE THOMAS ALVA EDISON FOUNDATION

THE Edison Pioneers, a group of former associates of the late Thomas A Edison, met on February 11 to commemorate the eighty eighth anniversary of the inventor's birth According to the *New York Herald Tribune*, William S Barstow, president of the group, announced that the formal incorporation of the Edison Foundation, deferred since 1932, would be carried out this year

In 1932 the Edison Pioneers and the American Institute of Electrical Engineers formed a joint committee, the International Edison Foundation, a permanent foundation to collect funds for the establishment of memorials and scientific fellowships in Mr Edison's honor

Eighty of 100 leaders of industry and finance who were interviewed during 1933 were of the opinion that Mr Edison's work should be recognized by the public in some substantial manner The other twenty held that every incandescent lamp, phonograph, motion picture or radio set was in effect an Edison memorial The committee, however, agreed that the progress of technical invention might leave all these devices outmoded and forgotten

As a result of conferences with the International Electro-Technical Commission and with prominent men in this country, action was postponed until 1935 because of adverse economic conditions, but the committee has now decided to incorporate in the near future under the name of the Thomas Alva Edison Foundation Trustees of the foundation will include members of the committee and representatives of the

Edison State Park Commission of New Jersey, the Association of Edison Illuminating Companies and the Edison family

Detailed plans will not be announced until after the incorporation has been completed, but it is intended to designate the week of October 14 as Edison Memorial Week and to have a campaign at that time to raise an endowment fund for the foundation

Mr Barstow was reelected president of the Edison Pioneers Other officers named were *Vice presidents,* Charles Edison, Frederick D Potter, Arthur Walsh and Ludwig F Ott, *historian,* William H Meadowcroft, *treasurer,* Frederick A Scheffler, and *secretary,* Frank A Wardlaw

FELLOWSHIPS OF THE AMERICAN ASSOCIATION OF UNIVERSITY WOMEN

THE American Association of University Women has announced the award of ten research fellowships to women for the coming year Five of the fellowships will be used for scientific research The awards were made by a committee of which Dr Emilie J Hutchinson, associate professor of economics at Barnard College, is chairman

Dr Jenny E Rosenthal, research physicist at Columbia University, who received the Sarah Berliner research fellowship, has been working for a year in the laboratory of Professor H C Urey, winner of the 1934 Nobel Prize in chemistry for his work with heavy water, and will continue her work there

The Latin American fellowship was given to Dr Perlina Winocur, physician on the staff of the University of Buenos Aires Medical School The award is offered annually by the association to give a qualified woman of Latin America a year of study in the United States Dr Winocur has devoted several years to a study of infant mortality in Argentina. She will continue her studies on hemolytic anemia next year at the Harriet Lane Home for Children, the Johns Hopkins Hospital, where she has been working during the past winter

The Mary Pemberton Nourse memorial fellowship was given to Lucy S Morgan, health education specialist in the Tennessee State Health Department, who will study the science of public health at Yale University after which she plans to resume her work in Tennessee

Mary S Pease, a student in archeology and recipient of the Alice Freeman Palmer memorial fellowship, plans to write a monograph on Corinthian imitations of Attic pottery Dr Pease has spent three years with the American School of Classical Studies at Athens, working on excavations in Athens and Corinth

The award to a university woman of some foreign country was given to Dr Gertrud Kornfeld, a German refugee and former lecturer of University College, Nottingham, England, who has won recognition for her research in photochemistry She will hold her fellowship at the University of Vienna

SCIENTIFIC NOTES AND NEWS

DR. ISAIAH BOWMAN, director of the American Geographical Society and chairman of the National Research Council, has been elected the fifth president of the Johns Hopkins University The announcement was made by Daniel Willard, president of the board of trustees, at the fifty ninth commemoration day exercises of the university on February 22 Dr Bowman will succeed Dr Joseph S Ames, who will retire on June 30 after having been connected with the university for fifty two years

DR. WILLIAM H WRIGHT, astronomer at the Lick Observatory, was appointed director of the observatory on February 24 by the board of regents of the University of California. Dr Wright, who has been a member of the staff of the university for thirty eight years, will begin his duties as director on July 1 He succeeds Dr Robert Grant Aitken, a member of the observatory staff for forty years and director since 1930, who is retiring from active duty

DR. GEORGE R. WIELAND, research associate in paleobotany at Yale University, has received notification from Dr Birbal Sahni, of Lucknow University, of his election as an honorary member of the Indian Botanical Society

DR. HARRY PLOTZ, formerly research chief of the Pasteur Institute and member of the Pierre Curie Institute of Paris, has been promoted from chevalier to officer of the Legion of Honor Dr Plotz, discoverer of the typhus fever germ and leader of the group which fought the typhus fever epidemic in Serbia during the world war, was the first American to be appointed a member of the permanent staff of the Pasteur Institute

AT the quarterly meeting of the council of the British College of Obstetricians and Gynaecologists it was decided to confer the honorary fellowship upon Nagiub Mahfouz Bey, of Cairo

THE Cameron Prize of the University of Edinburgh for 1935 has been awarded to Professor Julius Wagner-Jauregg, emeritus professor of psychiatry and neuropathology in the University of Vienna, in recognition of his discoveries regarding the malarial treatment of general paralysis

MAJOR WILLIAM E KEPNER, Captain A W Stevens, Captain O A Anderson and Mrs Jeanette Piccard received certificates of award on February 19 from the National Aeronautic Association for their stratosphere flights

DR HAROLD H PLOUGH, Rufus Tyler Lincoln professor of biology at Amherst College, has been granted a sabbatic leave for the current semester Dr Plough will spend a part of his time at the Bass Biological Laboratory in Englewood, Fla, in the study of marine fauna, followed by four months in the laboratory of the California Institute of Technology at Pasadena, where he will devote himself to genetics, particularly experiments with the heredity of the fruit-fly Before returning to Amherst in the autumn, he expects to continue his research at the Marine Biological Laboratory in Woods Hole

PAUL G REDINGTON, formerly chief of the bureau of biological survey of the U S Department of Agriculture, has been appointed forest supervisor of the Shoshone National Forest, Wyoming

DR RODERICK MACDONALD, assistant professor of zoology at Harvard University, was appointed director of the Philadelphia Zoological Gardens on February 13

DR. R BINFORD has retired from the presidency of Guilford College, North Carolina, and has resumed the professorship of biology

DR MATTHEW A HUNTER, professor of electrochemistry at Rensselaer Polytechnic Institute, has been appointed head of the newly created department of metallurgical engineering

DR. P R WHITE, for the past two years fellow of the Rockefeller Institute for Medical Research, has been appointed a member of the staff in the department of animal pathology of the Rockefeller Institute at Princeton, N J

DR EUGENE E GILL, associate professor of chemistry at the Armour Institute of Technology, has retired

DR W W COBLENTZ, chief of the division of radiology of the U S Bureau of Standards, is spending part of the winter at the School of Tropical Medicine in Puerto Rico, measuring the ultra violet intensity of the sun and standardizing the equipment to be used in the study of tropical physiology Dr Coblentz gave a lecture before the staff of the school on "The Problem of Evaluating Ultra-violet for Use in Medicine"

DR. WILLIAM W STIFLER, professor of physics at Amherst College, has been granted leave of absence for the second semester of 1934–35 He has planned visits to physics laboratories in France, Italy, Switzerland, and possibly Germany, with a three-months stay in England, where he will read and attend lectures at the University of Cambridge

MELBOURNE A CARRIKER, JR, in charge of Central and South American ornithology at the Academy of Natural Sciences in Philadelphia, returned on February 20 from a seven months' expedition into the jungles of Bolivia, where he collected 2,200 bird skins The collection includes more than 600 species, of which 150 have never before been recorded

DR. C A EDWARDS, metallurgist and principal of University College at Swansea, South Wales, recently arrived in the United States He will lecture at the Carnegie Institute of Technology, Yale University, the Franklin Institute and the U S Bureau of Standards

DR GARY N CALKINS, professor of protozoology at Columbia University, is conducting a protozoological survey of the mammals of Puerto Rico during his visit at the School of Tropical Medicine He lectured recently on "Protoplasmic Longevity with Special Reference to Protozoa" before the staff of the school

A SERIES of four weekly lectures on the racial origins and composition of the principal nations of the world was delivered during February by Dr Aleš Hrdlička at the U S Navy Medical School, Washington, D C

DR WILLIAM P MURPHY, of the Harvard Medical School and co winner of the Nobel prize in physiology and medicine, spoke on February 8 before the Greater New York Dietetic Association on his work with pernicious anemia

REV JAMES B MACELWANE, professor and director of the department of geophysics at St Louis University, delivered his third Lowell Institute lecture in Boston on February 8 His subject was "Some Old Seismological Problems and Recent Solutions"

DR. HARLAN T STETSON, research associate of the institute of geographical exploration at Harvard University, will give the Sigma Xi address at the University of Virginia on March 11 and at Duke University on March 12 His subject for both lectures will be "The Sun's Effects on Human Affairs"

THE ninth annual Priestley lectures will be given at the chemistry amphitheater at the Pennsylvania State College each evening from April 29 to May 3, inclusive These lectures constitute a memorial to Joseph Priestley, whose old home at Northumberland, Pa, is now owned and maintained by the alumni of the college A museum, containing all the Priestley relics which could be gathered together, now stands near the house This annual series of lectures was inaugurated by the faculty in 1926. In 1931, Phi

Lambda Upsilon, honorary chemical society, undertook the financial support of the Priestley lectures Each year the lectures deal with the borderline between physical chemistry and chemical physics and some other branch of knowledge This year's Priestley lectures deal with the borderline between physical chemistry and electrometallurgy They will be given by Matthew A Hunter, D Sc, professor of electrochemistry and head of the department of physics and electrical engineering at the Rensselaer Polytechnic Institute The subjects of his five lectures are as follows April 29, "Reactions in the Liquid State", April 30, "Reactions in the Solid State", May 1, "Physical Properties of Alloy Systems", May 2, "Physical Properties", May 3, "Special Applications"

THE fifth lecture of the Harvey Society was given by Dr E C Dodds, director of the Courthauld biochemical laboratory of the Middlesex Hospital, London, on "Specificity in Relation to Hormone and Other Biological Reactions" at the New York Academy of Medicine on February 21 The sixth lecture on March 21 will be given by Professor G V Anrep, professor of physiology, Egyptian University, on "The Relation of the Circulation in Voluntary and Plain Muscle to Activity"

THE annual meeting of the Kentucky Academy of Science will be held on May 3 and 4 at the University of Kentucky Titles for papers to be read at the meeting should be sent to the secretary, A R Middleton, Experiment Station, Lexington, Ky, not later than April 10

ATTENTION of investigators is called to the fact that, owing to the decreased resources at the disposal of the committee on grants in aid of the National Research Council (see SCIENCE for January 18, 1935), the committee will hold but one meeting this year, about the middle of May Applications to be considered at this meeting must be in the hands of the secretary of the committee, Dr C J West, 2101 Constitution Avenue, Washington, D C, on or before April 1 Applications received after the first of April can not be considered until the spring of 1936

THE liquid air and chemical demonstrations which were exhibited in the Hall of Science, at the Century of Progress Exposition, will be demonstrated by Dr Alden G Greene, at a meeting of the American Institute on March 4 at the American Museum of Natural History, New York

IT was announced on February 14 that a congress of physicians will be held on the steamship *Columbia* of the Panama Pacific Line from July 18 to August 28 under the auspices of the Pan American Medical Association The itinerary calls for a 12,000 mile cruise, during which scientific meetings in all branches of medicine will be held Stops will be made at Havana, Curaçoa, Rio de Janeiro, Santos, Trinidad, Santo Domingo and Kingston A five day scientific congress will be held at Rio de Janeiro and a three-day session at Sao Paulo The officers of the organization are as follows Dr Chevalier Jackson, president of the association, Dr Joseph Jordon Eller, director general, Dr Charles H Mayo, president of the section on general surgery, Dr Harlow Brooks, general medicine, Dr Charles Dennie, dermatology and syphilology, Dr P J Flagg, gas therapy

THE Belgian government has by royal decree officially recognized the International Office for the Protection of Nature, and has appointed the following delegates as its representatives to the general council for Belgium, Baron E de Cartier de Marchienne, Belgian ambassador in London, and Count Henry Carton de Wiart, formerly prime minister, for the Belgian Congo and the mandated territory of Ruanda-Urundi, P Charles, minister of colonies, and Dr V Van Straelen, director of the Royal Belgian Museum of Natural History and president of the institute for national parks in the Belgian Congo

A UNITED PRESS dispatch reports that on December 18 the National Geographic Society announced plans for another stratosphere balloon flight from the Dakota Black Hills for next June Captain Albert W Stevens, scientific observer and aerial photographer, will be in command of the balloon, piloted by Captain Orvil A Anderson Both officers participated in the ill fated ascent of the *Explorer* last July when it attained a height of 11¾ miles only to tear All three occupants parachuted to a safe landing Major William E Kepner, who commanded this year's flight, will be unable to take part because of Army air corps duties His place probably will be taken by Lieutenant Randolph P Williams, Langley Field, Va. The National Geographic Society will assume the major portion of the expense while the Army Air Corps, with the approval of the War Department, will supply the officers Dr Gilbert Grosvenor president of the society is reported to have said that the objects of the flight would be fourfold To check and test stratosphere data already obtained, to make additional photographic studies, to bring back samples of stratosphere air, and to make certain other new scientific studies

ACCORDING to a summary given in the *Journal* of the American Medical Association, there were 2,064,-944 births in continental United States in 1933, giving a rate of 16 4 per thousand of population, the lowest on record since the federal birth registration area was established in 1915, when it included only ten states and the District of Columbia, according to provisional statistics issued by the Bureau of the Census This

figure compares with a rate of 17 4 for 1932 for the birth registration area, which at that time did not include Texas. In 1933 the infant mortality rate was 58 2 per thousand live births as compared with 57 6 in 1932 New York with 187,139 births led the states with the greatest number of births Pennsylvania was second with 157,046, Texas is third with 107,924, and Illinois, 106 861 The states with the highest birth rates per thousand of population, however, are New Mexico, 26 7, North Carolina and Utah, each 22 9, South Carolina, 22 7, Mississippi, 21 6, Alabama, 21 1 and Virginia, 21 All except Utah are southern states and all largely rural The lowest birth rates are for Oregon, 12 2, and California, 12 4 Infant mortality rates, which are based on the number of deaths of infants under 1 year of age per thousand live births, are excessively high in New Mexico (134 2), and Arizona (111 4), both states with large nomadic Indian and Mexican populations which have little knowledge of infant care The next highest rate is 78 4 for South Carolina, which has a large Negro population The lowest rates reported are those for Washington and Oregon, 38 9 and 39 3, respectively A rate of 3 7 per hundred live births was noted for stillbirths

Nature states that a new high voltage laboratory at East London College enables that institution to offer greatly improved facilities for study and research in this branch of electrical engineering Towards the cost of its erection and equipment the court of the university made a grant of £12,000 and the Drapers' Company gave £5,000 and lent another £5,000 to enable the college to proceed at once with this and other enterprises The calendar for the present session announces that the equipment will include a 500,000 volt testing transformer, a surge generator with a maximum capacity of a million volts, a direct current generator of 200 000 volts capacity, a cathode ray oscillograph recording surge voltages up to a million volts, Schering bridge for measurement of dielectric losses, and transformers of 30,000–250,000 volts capacity for experiments A course in high voltage technology for degree students is being introduced under the direction of Professor J T MacGregor Morris.

AT a recent meeting of the administrative council of the Empire Cotton Growing Corporation it was reported that news was received in July of a serious misfortune at the cotton breeding station at Gatooma, where a considerable quantity of pedigree cotton seed was destroyed in a fire As a result, it was believed that only about half the quantity that would have been distributed to growers next season was now available The report noted that a new hybrid cotton, grown in Fiji, which, it had been hoped, might be comparable with Sakel, when tested this year was found still to lack strength, and it was doubtful therefore if it would find a market at a remunerative price The executive committee announced a decision to increase the grant made by the corporation to the funds of the Shirley Institute from £1,000 to £3,000 a year for a period of five years The director, in a comment on the report said that in Swaziland cotton was now being encouraged by the administration as a native crop Apart from the cash value of the crop, the inclusion of cotton in a rotation would do much to improve the native system of agriculture, which hitherto had been one of almost continual cereal cropping The corporation's staff were supervising the work of the native demonstrators who were assisting in the introduction of the crop

THE London *Times* reports that an ethnological expedition, headed by M Marcel Griaule, which proposes to study the religion, customs and life of the inhabitants of the district in the northern loop of the Niger, left Paris, France, on January 17 The expedition, which has been largely financed by Princess George of Greece, will travel in light motor lorries, and will go by way of Algiers, Colomb Bechar, Tamanrasset, and Gao to Timbuctoo The other members of the party are M Schaeffner, music, M Larget, topography, M Lutten, photography and native crafts, the Comtesse de Breteuil, Mme Hélène Gordon, and Mlle Paulme and Mlle Lifszyc The French Air Force at Gao has been instructed to put an aeroplane at the disposal of the expedition for its topographical work

NEW fields of cotton research are to be explored in England as a result of a £30,000 increase in the annual grant for this purpose from the cotton trade, we learn from the *Christian Science Monitor* This development was announced at the annual meeting of the British Cotton Industry Research Association in Manchester, when H R Butterworth, who presided, said that it had been decided that there must be no cutting down of the service essential to the industry to-day, and no neglect of fundamental research and advised that an expenditure of £82,000 per annum on cotton research will be necessary The advisory council of the Department of Scientific and Industrial Research, Mr Butterworth continued, had undertaken to make further grants for five years, dependent on the support given by the trade Conditional on the annual income of the association from the trade and other approved sources reaching £37,500 per annum for cotton research, the Government would make an annual block grant of £15,000, with further £500 for every £500 in additional trade subscriptions up to a maximum additional grant of £20,000 for each year This meant a minimum grant of £15,000 and a maximum grant of £35,000 against a maximum grant last year of £10,000

DISCUSSION

ATTITUDE MEASUREMENT AND "THE DUNLAP DILEMMA"

ON pp 207–8 of Dunlap's "Civilized Life," occurs the following

> Ask an adult what he would choose if he were offered the alternatives of total annihilation, or of beginning his life over again, living it up to the present moment exactly as he has lived it, to face again the same alternatives Make it clear that he is not, in his second life, to be allowed to profit by what he has experienced in the first and the answer almost always is that he would choose annihilation

The statement has far reaching implications, and its casual mention among local colleagues elicited questioning reactions, which interested the writer in briefly reviewing the topic, with the sources nearest to hand Accordingly a form was prepared, designed to represent fairly the conditions recited in the quotation above After slight verbal changes, its uniform text was as follows

Name is not needed Date Group
This inquiry is made to test the validity of a statement occurring in a standard psychological work
Assume that you are offered your immediate choice of the following
(A) To be totally annihilated
(B) To begin your life over again and live it up to the present moment *exactly as you have lived it not profiting by any experience of your former life* and then to be given the same choice of repeating your life, or annihilation
Put a check mark before whichever alternative you would prefer

The form was presented in such a way that no one needed to identify the answer, though actually this was often done Uniformly successful effort was, however, made to obtain record of sex and age to nearest decade Rationalizations, 'unconscious determinants" and various questions of definition are not considered here, the concern being limited to the verbal choice under the assigned conditions For convenience, choice of annihilation may be termed the "A" response, choice of reliving, the "B" response

Mainly through the interest of colleagues,[1] whose help is here gratefully acknowledged, were assembled the 121 cases that form the basis of the present note The material is highly selected, the majority are in the upper 5 per cent, and there is probably no one outside the upper 10 per cent of measurable "intelligence" Almost all are in the third and fourth decades of life, and they are mainly hospital and university personnel The data as here gathered show as a whole some one out of six A responses (20 of 121), whereas Dunlap indicates a marked preponderance of A responses Data from persons over fifty should be of relative interest, but are here nearly absent Any indications of sex difference should probably be looked on as of culture rather than sex

The response is a function of the way the person feels adjusted to life as a whole The largest proportion of A responses, one in three, actually occurs in that one of the groups living under the greatest socio economic frustration Another sample, of relatively favored status, yields but one A response in fourteen The factor of reliability also enters, a cycloid personality would fluctuate in response a schizoid maintain it The amount of alcohol in the system, and like factors, should be potent if temporary determinants There is some reason to believe that various group pressures inhibit the A response, with its vote of no confidence in the universe, a reason for 'secret ballot" procedure

There is a sample of 23 cases, additional to the above, consisting of college undergraduates, not chronologically adult ' Their proportion of A responses is 6 cases A further sampling, of 32 student nurses, ages ranging from 18 years up, yields four A responses, distributed as to age In the total material, 176 cases of whom it is safe to consider all as more than average adult in respect to intelligence ' at least, the A responses total 30 The possible roles of I Q, sex, socio economic milieu, etc, require larger material for their elucidation

It is a matter of some interest that such an apparently similar formulation of the inquiry should lead to a result so different from Dr Dunlap's wider experience therewith The most ardent local pride can scarcely ascribe it essentially to differences between value of life" or intellectual honesty, in Maryland, and Massachusetts or Rhode Island Moreover, not all the present samplings, at least, are of local origin Nor is it likely that appeal can be taken to differences of age or I Q If the real cause is an unrecorded difference in mode of questioning (e g subtle influence of the opening lines in the form here used) the result is strong support to Dunlap's long standing insistence on accuracy of procedural detail in experimental psychology The measuring of 'attitudes" is no exception

F L WELLS
BOSTON PSYCHOPATHIC HOSPITAL

[1] Especially Mr C R. Atwell, Dr Leonard Carmichael, Dr. Merrill Moore, Mr David Shakow

EARLY GEOGRAPHY IN NORTHERN ILLINOIS

CELEBRATION this year of the centenary of settlement in the Rock River Basin in extreme northern Illinois has brought to the surface memories which, unless recorded, will soon be lost.

Once the Indians were disposed of by the Black hawk War, the region invited white settlers Most of the early immigrants planned to take up farm land The margin between forest and prairie runs roughly east west through the district, with characteristic open glades in the fringes of the forest and peninsulas and islands of woodland (groves in local parlance) jutting up from the prairie The young men of 1834 and 1835 first on the ground, took up farms along the margins of the woods There they had logs for buildings rails for fences abundant fuel and springs and streams for quenching the thirst of man and beast Adjacent, on the unbounded prairie their stock could graze freely One of these first comers in after years told his son that when he took up his quarter section of land less than half of which was prairie, he took for granted he would always have unlimited, free, open range for all the animals he might own He and his neighbors planned to carve fields out of the woods The steel plow with self scouring metal moldboard was just being perfected, and no one foresaw that within a generation this plow would replace the native prairie with seeded crops (This district reached its heyday as wheat country during the high prices of Civil War days Later it turned to corn (maize), and to day it lies in the tran sition zone between the Corn Belt and the Dairy Province)

The grove which this settler and his contemporaries divided among them was typical of the forest margin About four miles long and one mile wide its axis was a small stream which headed in a 'big spring and peat bog in the nearby prairie Its wooded reach began in association with intermittent bluffs of soft limestone and the dissected high ground which they buttressed Some miles before reaching its forest fringed master stream it purled once more across a wide lowland of prairie which spread out at the base of low, stony, grass covered hills The vegetation of the grove consisted of oaks of at least half a dozen species, with a strong intermixture of hickories and a sprinkling of ash On the flood plain of the stream a few walnuts, butternuts, elms, locusts and haw thorns grew Poplars were common, chiefly on the margins of the grove which graded from dense to open woods and finally past isolated outposts to unbroken prairie Not all the outlying trees were poplars some were oaks, attested by stumps which stood in the fields until toward the end of the nine teenth century There was no underbrush and the trees branched high, permitting delicate woodland grasses to carpet the ground Three or four decades after the land was fenced hazel brush had sprung up thickly, in places making dense copse through which a man had trouble in forcing his way, sumac flour ished on dry, thin soil, and wild grapes and other undergrowth grew rank on the flood plain

Settlers who came in the 1840s, too late to find un occupied land along the vegetational contact zone, generally preferred the solid forest to the open prairie, but by 1850 men were actively enclosing the grassland, now recognized as more fertile than the land which had borne trees Each of these prairie settlers purchased or took up a five or ten acre tract of woodland in the heart of the forested section, in order to have fence and fuel wood When these small lots had been cut off, or when improved transporta tion substituted wire fences for rails and coal for wood as the source of winter heat in prairie homes, these lands were sold for a song to still later immi grants mainly Irish, many of whom had come in as laborers on the railroads

Towns grew apace with the countryside The earliest roads of the district connected navigable waters of the Great Lakes and Mississippi systems or reached out to the lead mines of the Driftless Area Settlements sprang up along these roads at forks and where they crossed streams which could furnish power for saw and grist mills Rivulets to day only five or ten feet across were considered adequate power pro ducers wherever their banks favored the construction of earthen or timber dams It is probable that these streams flowed more copiously in the early days of settlement—before the forests were felled and before the extensive marshes and bogs in depressions of the morainal prairie were drained by tiling Streams large enough to be dignified by the name "river" were beyond the control of the first settlers

When railroads came they followed water level routes so far as possible Hence they rarely coincided with the stage coach roads, which took the shortest lines between major objectives except where they skirted wet lands (flood plains and morainal depres sions) or made for natural fords across streams As population grew and mechanical devices multiplied, the rivers were dammed for power These two tech nological changes—railroads and power dams—pro duced mushroom growth on new sites and destroyed the hopes of many a stage route village A rapids in the master stream afforded the most convenient cross ing place, the Rock ford, and later made bridging easy This same rapids created the largest power unit in the area Roads, railroads and factories have made Rockford the metropolis, a destiny early recog nized when to it was allocated the county seat

The racial pattern of settlement reflects the stages of land occupance as determined by natural vegeta tion and water resources The first wave comprised New Englanders, coming either direct or after a so- journ of a few years or decades in New York State or the Connecticut Reserve of Ohio They, and one community of Scots, took up the groves and most of the contact zone between forest and prairie The stream of migrants next turned into the forest This

the Old Americans shared with a community of English families and with Pennsylvania Germans and Germans from the fatherland. Before all the forest land had been taken up, the new steel plow made the prairie available, and families from New England, New York, Pennsylvania and Germany joined forces in the rush to enclose it. Here and there a group of Irish took root on the prairie, but most of them were relegated by their poverty to the rougher forest lands which no one else had wanted. By the time the Irish and the Scandinavians were coming in force, they had to purchase farms from the children of earlier settlers, since little land remained in the hands of the government. Many of them settled in the towns. Before settlement was complete, all these racial threads were being interwoven into a harmonious fabric of Americans. This process still goes on with Italians and Lithuanians as the chief strands of later origin. Most of them are city dwellers.

While there was abundant land the different groups clustered in tight neighborhoods, each linked to a different place of origin. As soon as clannish feeling diminished with the passing of the first generation and all the land came to be occupied, the lines between settlements began to fade. Before 1900 the disappearance of stumpage in the forest and the planting of shade trees on the prairie had minimized the striking contrast in aspect of the landscape which had guided settlement. Intermarriage and interlopers were speedily obliterating the social lines which had formerly distinguished neighborhoods. But just as the natural vegetation has left tell tale traces in the soil, so relicts of the original settlement—denominational churches, varying styles of farmstead architecture, the predominance of surnames belonging to this or that language—indicate to the observing eye something of the origins of settlement on what is now a typical piece of Midwestern America.

DERWENT WHITTLESEY

HARVARD UNIVERSITY

OCTOBER 3, 1934

A NEW OUTLET FOR UNABRIDGED SCIENTIFIC PAPERS

THIRTY years ago it was not uncommon to find scientific papers forty pages long or even longer. Because of the increase in the number of papers submitted, editors nowadays are compelled to impose strict limitations on the length of each. Yet, because of increased specialization, the need for an efficient medium of interchange of detailed information, between workers in the same or related fields, is greater than it was ever before.

Several solutions of this problem have been proposed in the past.[1] They have a drawback in common—they require the concerted action of many scientific bodies as well as a radical change in the present methods of publishing scientific papers. These features in a plan make it highly improbable that the plan will be adopted in the near future.

I should like to have the opportunity of presenting through the medium of your journal a suggestion for the partial solution of this problem. This suggestion eliminates the difficulty mentioned in the preceding paragraph and allows of experimentation on a small scale.

The proposed procedure is somewhat as follows. Let the investigator write a paper of a length sufficient to make it useful to his fellow workers. Let him mimeograph his work and send copies to twenty five key libraries of the world. Let him then present a condensed summary for publication. The summary is to contain a complete list of the libraries in which the unabridged paper is to be found.

I wish to emphasize that the present plan introduces no startling or new ideas. It represents a synthesis of several separate old ones. It seems to me that it is practical and that it will make unabridged papers equally as accessible as short papers published in the less widely circulated journals.

MILTON J. POLISSAR

ARMSTRONG COLLEGE
BERKELEY, CALIF.

SCIENTIFIC BOOKS

EARTH, RADIO AND THE STARS

Earth, Radio and the Stars. By HARLAN TRUE STETSON, Ph.D. New York, Whittlesey House, McGraw-Hill Book Co., Inc., 1934, pp. xvii + 336, figs. 88, one colored plate.

A PUBLICATION describing and coordinating the intriguing phenomena of astronomy and those of the earth sciences, more familiar but unfortunately the object of less interpretation, has been a desideratum for some time. The wonders of the heavens and the enchantment of the great unknown represented by the distant celestial bodies have long been the subject of discussion both scientific and popular. It is surprising that the even more complex and certainly equally fascinating physical phenomena evidenced by the experiments performed daily by nature in her great laboratory—the earth and its atmosphere—enlist, in general, little interest from layman and scientist alike. In astronomy there has been no lack of interest from its early beginning. But the intimate relations to the

[1] See, for instance, SCIENCE 56: 197, 1922; 80: 70, 1934; 80: 245, 1934.

problems of life and our whole environment, so essential to human welfare and progress, because of their very familiarity have met with only limited inquiry and certainly have received little support in comparison to that accorded other fields of scientific investigation

Dr Stetson has done a service to geophysicists, astronomers and laymen in this attempt to present in popular form what we know of the physics of the earth and how that knowledge fits with, relates to and expands interpretation of observations in the, as yet, inaccessible regions immediately around the earth and in space His book should enlist the attention of thoughtful readers and give them a new view of and insight into the familiar everyday phenomena occurring around us and unobserved by almost all

Dr Stetson's expressed purpose to bring together recent conspicuous developments in astronomy and its related fields which may suggest a more intimate relationship between man and his cosmic environment, than has perhaps been generally supposed' is thus well justified For this study of the relations of the earth to the cosmic scheme he suggests the name *cosmecology* implying the notion of ecology as used in a biological or botanical sense

It has been little realized until late years how intimate are the relations which exist between astrophysics the physics of limitless space—and geophysics—the physics of the earth The task presented is a large one, involving scientific minutiae and technique of astronomy, of geophysics (as represented by meteorology, oceanography, terrestrial magnetism, volcanology, seismology, hydrology, geodesy, geology), of wireless telegraphy and of all their interrelations—some quite patent, others hidden in the hazy boundaries of our finite understanding

Naturally the heterogeneity of the materials to be presented and digested in a popular style derived from so many diversified and specialized fields constitutes a herculean task In this the author is to be complimented upon his general success At times apparent interrelations suggested by various persons and noted in the book are not susceptible of rigorous scientific scrutiny One might have hoped that an expert like Dr Stetson would have more frequently made clear cut distinctions between interrelations based upon generally accepted materials in these fields and ideas of a more or less speculative nature However, limitations of space and the brevity demanded by the average reader do perhaps condone omission of digressions of this kind

The chapters describing tides of the ocean and earth, of variations in latitude and longitude, are excellently treated The subject of the earth's interior is treated from conclusions based on the investigations and progress made by seismic methods In the four chapters dealing with the effects of the sun on human affairs, on the earth's magnetism, on radio reception and on the ionized regions, our limitations of knowledge are perhaps more clearly indicated Much space is devoted to the discussion of radio in relation with the moon, solar eclipses, meteors and the stars It is perhaps still open to question whether the published investigations of the author and his associates have been sufficiently rigorous to discriminate between the effects of the lunar cycle and the solar cycle, the proof of which requires an extremely detailed statistical study over a longer period of time than yet available

Under the chapter on illuminations of the night sky, attention is given chiefly to considerations of the aurora and zodiacal light In discussing the former the results of recent work, particularly by Norwegian investigators, are briefly sketched In introducing the subject the author states that "Relatively careful observations show that in general these strange illuminations center about the Earth's magnetic poles' It is not clear just what 'relatively careful observations' are referred to, but the statement is not in accordance with generally accepted data It might better be said that the line of maximum auroral frequency in the northern hemisphere is roughly symmetrical about the axis of the earth's uniform magnetic field, the north end of which is approximately in latitude 78° 32′ north and longitude 69° 08′ west

Two of the final chapters of the book deal briefly with cosmic clouds and cosmic rays The subject-bibliographies arranged according to chapters are well selected The indexes for both name and subject show an appreciation of the usefulness of such features to the reader and student

The publishers have presented Dr Stetson's text and numerous diagrams in attractive form

J A FLEMING

CARNEGIE INSTITUTION OF WASHINGTON

ASTEROIDAL AND COMETARY ORBITS

The Calculation of the Orbits of Asteroids and Comets By KENNETH P WILLIAMS Principia Press, Inc, Bloomington, Indiana Pp vii + 214 $3 25

THE author's chief purpose in writing this book was to provide the mathematics student with a mathematical exposition of the methods for the computation of preliminary asteroidal and cometary orbits There can be no doubt that this purpose is well achieved The general introductory chapters serve to provide him with the basic ideas of what astronomical positions mean, the systems of coordinates used and the corrections to be applied Very little of the observational side is presented, but that is not necessary in this type of treatment The introduction of a chapter

on interpolation enhances the value of the book considerably, especially for the student who wishes to compute The mathematical foundations of the Laplace, Gauss and Olber methods are clearly presented, especially in the case of the last The historical sketches, though brief, add greatly to the interest and value of the book These, coupled with the rather complete bibliography, make the book of considerable value for reference purposes

The chief criticisms apply to the treatment of practical details necessary for the student who wishes really to learn to compute orbits The formulas for computation are in some portions very detailed and in others somewhat sketchy They are, however, designed for machine computation which is a definite advance The omission of plus signs in the numerical examples is in bad form for the student learning machine computation, but, of course, the instructor should watch over such details

One would rather expect Moulton's Celestial Mechanics' to be used as a standard of notation in an English text but one finds ξ, η and ζ representing the direction cosines when usually they represent geocentric coordinates in orbit theory Other changes in notation may cause confusion The failure to identify explicitly the well known f and g series in the modified Laplacian method may possibly save computation time, but the treatment almost completely masks these most important series Their omission as definite entities prevents the student from appreciating the tremendous flexibility of the modified Laplacian methods such as Leuschner's when applied to the many problems that the orbit computer will meet

I can find no mention of Bengt Stromgren's modification of Olber's method, though his nomograms for the solution of the geocentric distance are of great value in computation, both by Olber's and Leuschner's methods

One may say of the book generally that in spite of certain deficiencies in the practical treatment of orbit computation, it affords the most complete text on the subject available in the English language This book should stimulate activity in a part of astronomy somewhat neglected at the present time

FRED L WHIPPLE

HARVARD OBSERVATORY

QUOTATIONS

A MESSAGE FROM THE PRESIDENT OF THE AMERICAN CHEMICAL SOCIETY

WITH the American Chemical Society entering a new year, the fifth of the depression, a circumspection of its affairs may well be made The society is in a strong position On account of the interest and efficiency of its permanent officers the editors of the journals and their staffs, the American Chemical Society is in the front as one of the outstanding scientific organizations of the world With the cooperation of the members it will always remain so The society has weathered the last five years without serious impairment of its functions and there is every indication that the next years will present easier sailing

The high standard of excellence of the society's journals is accepted by all The national conventions and intersectional meetings of the society are a tremendous stimulation and inspiration to the members, and at the same time attract public attention It is difficult to suggest basic improvements in these two interests of the society There is still a third function of the organization, the improvement of the professional standing of the chemist, which may very briefly be discussed That the chemist should be pictured in the minds of the public in the same category as the physician, engineer or lawyer, is the desire of all who understand chemistry There are at least two viewpoints as to how this may be best accomplished, and only time will crystallize the policy which the society as a whole should support Without mentioning all of the various factors which have aided the professional standing of the physician and of the engineer only the one which is perhaps the most influential need be cited —the necessity of state examinations and registration Is the chemist, in order to attain a greater professional standing, willing to accept state examinations and registration before he can practice or become a properly qualified chemist in the eyes of many business executives? Although such a plan will effectively assist the chemist in gaining public recognition nevertheless years would pass before a system satisfactory to the chemist and to the states could be evolved and before this plan might accomplish its purpose

The alternative is to educate the public gradually in the manner that has been taking place during the past ten or fifteen years The industries have manufactured more and more products which touch directly the layman and which are advertised to him as the result of chemical investigations With such products steadily increasing in number and with the numerous interesting press reports of discoveries involving intricate pure and applied chemistry, the professional standing of the chemist with the laity is bound to improve

The trained chemist is truly in a favored position to day The past decade has seen his services first greatly in demand, and has then seen them diminish, until three years ago a current topic of conversation

among university professors was the problem of employment for the newly trained chemists The picture has changed once again in the last two years Unemployment has diminished rapidly until the number who are not placed, and whose training qualifies them for a research position, is relatively small In fact, it does not now appear to be presumptuous to predict the possibility of a shortage of research chemists within a few years This situation has been created through the recognition by the executives of an ever increasing number of our industrial organizations of the value and necessity of research More and more chemists are being diverted to executive positions, to sales or legal departments in various organizations The desirability of a technical training in these fields is not yet fully recognized

Compare the chemical profession with any other Is not the outlook for the chemist very encouraging?

—*Roger Adams*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SECOND EXPERIMENTAL METHOD FOR INCREASING AUDITORY ACUITY[1]

In previous publications[2, 3] fixation of the round window membrane with a pledget of cotton or with a living tissue graft was shown to increase the intensity of tones transmitted through the cat's ear from 10 to 30 decibels In all these experiments the Wever and Bray phenomenon was used to measure the strength of action currents set up in the animal's auditory nerve as a result of the specific sound stimulus applied to the ear It was shown later[4] that measured increases in intralabyrinthine pressure tended to improve the intensity of tones transmitted, though only to a slight degree, the higher frequencies were affected more than the low Decreased intralabyrinthine pressure resulted in a marked lowering of the intensity of all tones transmitted

In the present series of experiments an attempt was made to block the cochlear aqueduct This was done by drilling a hole with a small dental burr over the position of the aqueduct well away from the cochlea itself The base of this hole was then scorched with a high frequency cautery, hoping thus to occlude the aqueduct In two experiments the burr actually perforated the wall of the bulla, and, following recovery from anesthesia, these two animals exhibited what was apparently a cerebellar ataxia In neither case was nystagmus present Fourteen such operations were performed under strict aseptic technique Five animals have been tested subsequently at intervals of from two to three weeks following the original operation In every instance the intensity of spoken voice was greatly increased on the operated side, using the normal ear as control In addition pure tones of the octaves from 1,000 d v to 8,000 d v were increased from 10 to 25 decibels over the normal ear

To demonstrate occlusion of the aqueduct 10 cc of a 30 per cent NaCl solution was given intravenously While the usual rapid falling off of intensity was noted on the normal side, much less effect could be observed on the experimental side Certainly no greater lowering of pressure took place than might be accounted for by absorption of fluid through the capillary beds of the inner ear itself Without waiting for the histologic evidence of serial sections it seems safe to assume that the aqueduct had been occluded successfully The intensity measurements of such an experiment follow

Frequency	180	250	500	1 000	2,000	4,000	8 000
	Right ear (Operated)						
Control, before injection NaCl	27	29	19	29	19	24	70
Immediately after injection	33	24	23	40	26	30	66
½ hour after injection	30	25	26	42	30	35	
	Left ear (Normal)						
Control, before injection NaCl	21	23	33	40	40	50	
Immediately after injection	19	22	34	37	55	58	
½ hour after injection	20	25	44				

The figures beneath the different frequencies represent decibels of attenuation necessary to balance the comparison intensity with the intensity of tone transmitted through the cat's ear

Two possible explanations of the results observed present themselves In the first place occlusion of the duct may result in a gradual increase of intralabyrinthine pressure with the resultant improvement in the transmission of the higher frequencies In the second place the cochlear aqueduct may serve in a minor capacity as an additional safety valve for the cochlea This function of the round window membrane was originally put forward by Hughson and

[1] From the Otological Research Laboratory and the Surgical Hunterian Laboratory the Johns Hopkins University School of Medicine Aided by a grant from the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation

[2] Walter Hughson and S J Crowe, *Jour Amer Med Asso* 96 2027–2028, June, 1931

[3] Walter Hughson and S J Crowe, *Ann Otol Rhinol and Laryngol*, 41 832, June, 1932

[4] Walter Hughson, *Am Jour Physiol*, 101 396–407, July, 1932

Crowe[5] and more recently additional evidence to support the theory has been reported by Hughson and Witting[6] True, it would seem unlikely that the cochlear aqueduct was of sufficient size to function in this "safety valve" capacity

In all but one of the animals tested the bulla and middle ear on the operated side were entirely clear when examined at autopsy In one case granulations filled both the middle ear and bulla, making the improved transmission of all frequencies even more remarkable

CONCLUSIONS

(1) Experiments designed to obstruct the cochlear aqueduct in cats have resulted in a marked increase in the intensity of spoken voice and pure tones transmitted by the operated ear

(2) Without histologic proof of actual occlusion withdrawal of fluid from the labyrinth and the resulting decrease in efficiency of the ear by intravenous injection of a hypertonic NaCl solution has been definitely obviated by the experimental procedure

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A SIMPLE METHOD FOR MAKING LOW-POWER PHOTOMICROGRAPHS

SEVERAL days ago it became necessary to make a series of low magnification photomicrographs of insect dissections Believing that other organizations may be in the same financial position as we are and in need of such an apparatus prompts me to describe it It was made from materials found in the laboratory and cost only a little time

An ordinary student's microscope is mounted upside down on a vertical iron rod by means of two condenser clamps Above it is similarly fixed a 300 watt gas filled electric lamp A housing that might be used for projection drawing is fashioned of a light wooden frame and beaver board The measurements of this box are 12 high by 24 by 18 with the bottom and the 24 front open A hole cut into the center of the top fits snugly around the microscope tube As the device now stands it may be used as a small demonstration projector for class work or for making projection drawing

To convert it into a camera all that is needed is a blanket or a large piece of black oilcloth We used three regular rubberized laboratory aprons The operator sits in the position to make a projection drawing and envelops himself and the open side of the housing with the dark cloth The plates used are Eastman Slow Lantern Slide Positives The plate holder is an empty lantern slide plate box The procedure is simple The slide is focused on a piece of paper as for drawing The closed lantern slide box containing a plate emulsion side up is moved into place and the light turned off The cover of the box is then removed and the light again turned on for the duration of the exposure The cover is then replaced and the slide taken to the dark room for development

We found that so long as the operator was unable to read the lettering on the box cover the interior of the camera was safe for these plates Satisfactory negatives were made with the following combinations and exposures

Objective	Ocular	Projection distance	Exposure
16 mm	7 5×	11 inches	20 sec
Zeiss a₂ 3×	7 5×	11 inches	2 sec

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SPECIAL ARTICLES

SELENITE—A CRITERION OF EFFECTIVE WIND SCOUR

THE future student who explores the intricacies of geomorphic literature will, according to his nature, be amused or exasperated in comparing Lang's note "Selenite Not a Certain Indicator of Wind Effect"[1] with our note published four years earlier[2] entitled "Selenite Fragments or Crystals as Criteria of Wind Action"

We hold that laboratory experiment in sandblasting produces a frosted surface on selenite so quickly that it is inconceivable that bright selenite fragments could exist in an area having effective action by wind blown sand We suggest that selenite surfaces are dulled by solution within a few years in the climates prevailing in most parts of the United States where such fragments are found on the surface Yet even this is a long time compared to the few minutes necessary for frosting by the sand blast Therefore the presence of such fragments on the surface may be used as indicative of the general absence of effective wind scour

[5] See note 2

[6] Walter Hughson and E G Witting, *Acta Oto Laryngologica* (in press)

[1] Walter B Lang, SCIENCE, 80 117–118, August 3, 1934

[2] Walter H Schoewe and Kirk Bryan, SCIENCE, 72 167–170, 1930

Now Lang cites crystals of selenite thrown out of a railroad cut in 1891 near Salt Draw, twenty miles south of Carlsbad, New Mexico These crystals have bright cleavage faces due to the lack of tools sufficient to make wind action effective ' It should be noted also that these bright" cleavage faces have persisted for over forty years Can it be possible that the masses of selenite have been broken and rebroken by casual passersby?

In this region Lang points out that dust is carried in the air, that sand is blown out of the bed of Pecos River and that soil is lifted from cotton fields All these phenomena occur, and one of the present writers can confirm the observations by personal experience as the result of field work in this area However, our statements quoted above make no claim that selenite fragments or crystals are criteria bearing on deflation and wind transportation but merely on corrasion by wind blown sand, *i e* wind scour All criteria of geomorphological process must be used with caution and applied to the process to which they pertain

If we consider the area adjacent to Pecos River near Carlsbad and particularly that south towards Pecos City, Texas, the dominant land forms are pediments and terraces produced by stream action, either of Pecos River or of its tributaries These features record three gradients of Pecos River, 30, 75 and 150 feet above its grade The broad and recently abandoned flood plain is actually a terrace 20 feet above river grade The two higher terraces are described in print[3] and the lower terrace, only 10 feet above the flood plain or about 30 feet above river grade, is described in a manuscript report[4]

The sequence of terraces appears to be the same as that so admirably described by Nye[5] for the Roswell area The recently abandoned flood plain of the river is Nye s Lakewood terrace, the 30, 75 and 150 terraces correspond to the Orchard Park Blackdom and Diamond A surfaces

In addition to stream erosion, ground water solution of salt gypsum and limestone beds is very active There are numerous sinkholes joined by the destruction of intervening rises The solution of caverns and their collapse is also accompanied by deposition of material in the caverns, as pointed out by Lee[6] In the area south of Carlsbad, the sinkhole or Karst topography is less developed west of the river than east of it Nevertheless, near Salt Draw on the west side of the valley close to the locality noted by Lang the generally stream modeled topography is modified by solution and fill

East of the river a great mantle of wind blown sand partly conceals the details of a topography whose major features are dissected pediments modified by sinkholes The sand has been lifted from the channel of Pecos River and its eastern tributaries by strong westerly and southwesterly winds This process goes on at present and apparently was characteristic of each of the previous erosional stages But this movement of sand and its accumulation to form the extensive body shown on Darton s geologic map of New Mexico and referred to by him[7] as the Mescalero Sands" takes place on the east side of the valley The existence of these sands and the extensive wind work to which they testify does not, however, indicate wind scour on the west side of the valley Even within the area of the sands, wind scour is at a minimum, as this area is primarily one of deposition The more or less continuous rearrangement of the sands by wind leads to wear of sand on sand, not to wear of sand on the underlying bedrock, *i e* true wind scour

Thus a careful reading of Lang's paper and a consideration of the area to which he refers indicates that he actually uses selenite fragments as criteria for wind scour in the way and to the extent that we indicate, in spite of his somewhat confusing title

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THE OCCURRENCE AND ACTIVITY OF UREA-SPLITTING BACTERIA IN THE SEA

It is recognized that microorganisms which ferment urea play an important rôle in the nitrogen cycle and in soil fertility, and they are known to be quite widely distributed in soil, sewage, manure and fresh water There are fragmentary accounts of the occurrence in the sea of urea-splitting bacteria, but most of the work has been done in bays or near shore During the past thirty months we have been making observations to ascertain if there are significant numbers of urea splitting bacteria which are functional in and indigenous to the sea, or if those found in the sea are merely passive terrestrial contaminants

Numerous samples of water and bottom deposits have been collected at sea from the boat *Scripps* by

[3] O E Meinzer B C Renick and Kirk Bryan, *U S Geol Survey Water Supply Paper* 580A, p 6, 1926

[4] Kirk Bryan Geology of Avalon Reservoir Carlsbad Irrigation Project New Mexico with respect to proposed increase in height of the dam, Feb, 1927 (Files of the Ground Water Division, U S Geological Survey)

[5] A Y Fiedler and S S Nye U S Geol Survey, *Water Supply Paper* 639, pp 10–14, 1933

[6] W T Lee, U S Geol Survey, *Bull* 760, pp 107–121 1925

[7] N H Darton, U S Geol. Survey, *Bull* 794, p 59, 1928

such rigorous sampling technique[1] as to preclude possibilities of terrestrial contamination The samples were inoculated into selective media consisting of Mandler filtered sea water containing 2 0 per cent urea and 0 2 per cent each of glycerol, dextrose and calcium lactate The hydrogen ion concentration was maintained near pH 8 2 by the addition of magnesium carbonate Following incubation, growth and ammonium formation were used as the criteria of urea fermentation

The relative abundance of urea splitting bacteria was estimated by using inocula consisting of different dilutions of the water or mud samples The majority of the 1 0 cc inocula of water collected near the surface yielded positive results, nearly half of the 0 1 cc inocula did likewise, and the 0 01 cc inocula did so only infrequently Obviously, this indicates the presence of from 1 to 10 physiologically active urea splitting bacteria per cc of sea water Similar deductive analytical procedures revealed that this is approximately the order of magnitude of the number of urea splitting bacteria found throughout the euphotic zone to a depth of 50 meters in the Pacific Ocean in the region of Scripps Institution Occasionally, urea splitting bacteria are encountered in water 500 meters deep, but, in general, very few are found below depths greater than 100 meters However, that neither depth nor the accompanying hydrostatic pressure are limiting factors has been shown by the recovery of numerous urea-splitting bacteria at depths exceeding 1,000 meters Analysis by the dilution method of 16 mud samples collected at depths ranging from 160 to 1,300 meters showed that the surface mud contained from 10 to 1,000 urea splitting bacteria per gram From the examination of cores it was found that these bacteria are most abundant in the upper 2 to 3 cm of mud, and decrease progressively with the depth of the cores Also, urea splitting bacteria have been demonstrated associated with the integumental slime and intestinal contents of several marine fish

Twelve pure cultures of urea splitting bacteria, differing morphologically or physiologically from each other, have been obtained by streaking inocula of the enriched cultures on urea sea water agar These have been characterized according to standard methods[2] Apparently they are new species and will be described elsewhere Most of these cultures are quite different from the terrestrial urobacteria which have been described

As further evidence that these urea splitting bacteria are functional in and indigenous to the sea and probably even foreign to other habitats, it was noted that following primary isolation the majority of them would grow only in sea water media and not in corresponding media prepared with fresh water However, by the use of massive inocula, by gradually diluting sea water media with fresh water, or by prolonged laboratory culture these marine urea splitting bacteria could be acclimatized to grow in either sea water or fresh water media This is a characteristic which is common to many bacteria isolated from the sea under conditions which preclude chances of contamination and has been discussed previously[3]

Although the authors are not convinced that bacterial urease is elaborated extracellularly, this enzyme has been demonstrated by the Mandler filtration of 750 cc quantities of substrata which have been acted upon by the bacteria The optimum temperature for the activity of the urease from one culture was found to be several degrees higher than the optimum temperature for the reproduction of the culture Also, whereas the activity of the isolated urease was imperceptible after several days incubation at +5° C, the bacteria from which the urease was extracted multiplied and formed ammonium from urea at −4° C The explanation of this equivocal observation may be a difference in the quantity of enzyme or it may be the lack of certain co enzymes in the isolated urease extract which are associated with the intact bacterial cells Whether or not urea splitting bacteria are functional at near zero temperatures is especially significant in the sea, inasmuch as over four fifths of the ocean floor is perpetually colder than 3° C Rubentschik[4] has commented on the activity of *Urobacillus psychrocartericus* at temperatures as low as −2 5° C

On a basis of their relationship to the substrate three different types of urea splitting bacteria have been isolated from the sea (a) Those which grow well in media containing no other source of nitrogen except urea, but liberate no detectable excess of ammonium We classify these with the urea splitting bacteria because it is believed that they must cleave the urea molecule before the nitrogen of the latter can supply the metabolic requirements (b) Those which multiply freely in urea media and produce an excess of ammonium Some of these produce enough ammonium to make the sea water as alkaline as pH 9 7 These bacteria may play a rôle in the precipitation of calcium carbonate from sea water[5] (c) Those which do not start to multiply in urea media unless a little ammonium, amino acid or peptone nitrogen is added to initiate multiplication, after which urea is decom

[1] C E ZoBell and C B Feltham, *Bulletin*, Scripps Instit Oceanog, tech ser, 3 279–296, 1934

[2] Soc Amer Bacteriologists, "Pure Culture Study of Bacteria," Geneva, N Y, 1931

[3] C E ZoBell and C B Feltham, Fifth Pac Sci Cong, Victoria and Vancouver *Proc* vol 3 pp 2097–2100, August, 1934

[4] L Rubentschik, *Centralbl f Bakt*, II Abt 64, pp 166–174, 1925

[5] W Bavendamm, *Archiv f Microbiol*, vol 3 pp 205–276, 1932

posed with the formation of ammonium We have observed no marine bacteria which require urea for their growth

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A GROWTH-INHIBITING SUBSTANCE IN LETTUCE SEEDS[1]

LETTUCE seeds which fail to germinate on moist blotters at 25° C in the light may be germinated at this temperature by placing the seeds on moist absorbent cotton or in water[2] The increased germination obtained by this method suggests that the promotion of germination may be due to the exit of an inhibiting substance which diffuses from the seed into the aqueous medium If an inhibiting substance is formed during the process of germination then the repeated placing of seeds in contact with the same substratum should cause a gradual reduction in the percentage of germination The germination tests that have been made on cotton and in water to test this hypothesis show that lettuce seeds do form a substance of unknown nature which diffuses from the seed, and if present in sufficient quantities prevents germination

The inhibiting material is formed most readily by freshly harvested seeds of the white seeded varieties of lettuce which tend to go into dormancy at 25° C Big Boston lettuce seeds which germinated 3 per cent on moist blotters at 25° C in the light germinated 80 per cent when placed on moist cotton The percentage of germination upon this same cotton medium was reduced to 5 per cent after five lots of 100 seeds each had been in contact with the medium over a period of 10 days In like manner germination in a shallow layer of water was completely inhibited after 600 seeds had been in contact with the medium When the water from a similar inhibiting medium was used to moisten a freshly prepared cotton substratum the germination of lettuce seeds upon the cotton was reduced from 80 per cent to 10 per cent A saturated medium which inhibited the germination of Big Boston seeds at 25° C failed to prevent the germination of Black Seeded Simpson seeds of the same age, which indicates that the physiological condition of the seed is a factor in determining the response made by seeds to the inhibiting substance

The increased germination of lettuce seeds in the light indicates that light may promote the diffusion of the substance from the seeds, and although light may accelerate the process, tests have shown that an inhibiting substance passes from the seeds in total darkness A cotton medium upon which 600 new crop lettuce seeds had been in contact for a period of 10 days in the dark, and then used as a substratum for germination in the light completely inhibited the germination of one-year old Big Boston seeds When this cotton medium was washed in water and then used as a substratum a similar lot of seeds germinated 98 per cent

The age or more specifically the physiological condition of the lettuce seed is a factor influencing the formation of the inhibiting substance, and is also a factor in determining the response made by seeds when placed in contact with a saturated substratum The inhibiting substance is formed most abundantly by seeds immediately after harvest and in smaller amounts or not at all in old seeds, and appears to be in some way associated with the dormant condition which develops in the seeds when placed at unfavorable temperatures for germination The marked increase in germination obtained in the light indicates that light may facilitate the passage of the inhibiting material from the seed The response to light is complicated by the fact that the dormant condition in light-sensitive lettuce seeds can be broken by placing the seeds in an atmosphere that is saturated with water vapor and giving them an exposure to light The latter response may take place in swollen seeds within a few seconds and without the presence of water in the form of a film surrounding the seed which precludes the possibility of any substance diffusing from the seed The fact that the material may pass from the seed in total darkness indicates that the function of light is to prevent or break the stable condition of unknown nature which characterizes seeds in secondary dormancy

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[1] Approved by the director of the New York State Agricultural Experiment Station for publication as Journal Paper No 53, October 24, 1934

[2] A L Shuck, *New York State Agr Exp Sta Tech Bul* No 222, 1934

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Committee on Community Dental Service of the New York Tuberculosis and Health Association *Health Dentistry for the Community* Pp xiii + 85 University of Chicago Press $1 00

FRITSCH F E *The Structure and Reproduction of the Algae* Vol I Pp xvii + 791 245 figures Macmillan $8 00

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Report for the Year 1933-34 of the Department of Scientific and Industrial Research Pp 192 His Majesty's Stationery Office, London 3s

SCIENCE

VOL. 81 FRIDAY, MARCH 8, 1935 No 2097

SCIENCE A Weekly Journal devoted to the Advancement of Science edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster Pa Garrison N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

MAN, THE GREAT INTEGRATOR[1]

By Dr WILLIAM A WHITE

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FROM the point of view of the circulatory system we may think of one of the higher mammalian organisms in terms of the systole and diastole of the heart With the heart's contraction a powerful stream of blood is forced into the systemic circulation to find its way through vessels of ever decreasing diameter to smaller and smaller areas of irrigation In this way the oxygen carried by the blood corpuscles is distributed to the most remote portions of the body Then when the force of this contraction has spent itself the heart pauses for an instant and during this pause receives from all these outlying districts of the body the blood which, having been deprived of its oxygen, has by another mechanism been circulated through the lungs to receive a new supply, and when this is done a further contraction sends this new supply along the same paths as before This constant pulsation which distributes the vital fluid is characteristic in a sense not only of all living matter but of everything organic and inorganic in the cosmos Wherever we look we find motion, and wherever we find motion we find rhythm or periodicity of some sort We might therefore reasonably expect, and as a matter of fact do find, that these same principles which control elsewhere are observable in the field of psychological phenomena The particular aspect of these phenomena to which I would draw your attention are the systole and the diastole of human knowledge, which expresses itself in the constant tendency, so well manifested in the field of medicine, to the development of medical specialties and in the field of science to the separate development of the various sciences It is the tendency to differentiate, on the one hand, and on the other the reciprocal tendency to bring together, into a common reservoir, as it were, by a process of co-

[1] Address at the opening session of the American Association for the Advancement of Science, Pittsburgh, December 27, 1934

ordination and integration knowledge from several or from all fields. These two tendencies of differentiation and integration which we see exemplified in this manner are not separate and distinct processes but are the two aspects of advancing knowledge, and it is the recognition of this fact and of the part that man plays in this forward movement about which I wish to speak briefly to night.

In the first place, I call your attention to the fact that this way of looking at development and evolution gives us a different picture of the organism from the one that maintained during the last century. At that time we were thinking not of a constant flux of energies without rest or equilibrium at any point, but we were thinking in terms of static pictures. Medicine in particular had developed a concept of the human organism that was largely dominated by the revelations and discoveries emanating from the autopsy room. We looked through the microscope and we saw pictures beautifully colored of cells and fibers, and we jumped to the conclusion that such cells and fibers as we saw there actually existed in the living being, and so there was built up a concept of living organisms which really as a condition precedent demanded that they be dead. It was the mosaic theory, the theory that the organism was composed of cells, that the cells united to form tissues, and the tissues to form organs. In the nervous system we found the reflex arc to be the unit of structure, and in the mind, by a parity of reasoning it was the sensation. Somehow we believed that a number of cells could be brought together by a process of addition to form tissues and organs, that a number of reflex arcs could be added together and when enough hundreds of thousands of them had accumulated we had the mammalian nervous system, that a number of sensations could in the same way be put together to form a mind. This resulted in a sort of kindergarten idea of a living organism, based somewhat, I suspect, upon the foundation of the five special senses and gave us in the final analysis a picture quite in harmony with the smug complacency of the mid Victorian era. The unfortunate thing about it all is that we still find it easier to think in these terms than we do to think in terms of the more modern concepts because we were brought up with these old ideas, they formed part of the habits of our more youthful thinking, and they have been imbedded and preserved in the structure of our language. It requires, therefore, a more than ordinary wrench with the past to free ourselves from these hampering traditions and to be able to think and feel and act as if they were no more.

In the field of general science these traditional ways of thinking have received in recent years a number of very serious jolts. The constitution of matter as made up of molecules and atoms has had to give way to the discovery of a sub-atomic world of bewildering complexity. Along with this new discovery there disappeared the idea of the fixity of the chemical elements and with the discovery of radium emanations, the dream of the old alchemists came true when elements were transmuted one into another. Carnot's principle, which had held sway for so long and which taught that the universe was cooling off and gradually settling down to equilibrium and death, has been called in question by the cosmic rays of Millikan if in fact life itself does not contradict it, and in the field of the study of mind it has been found that beneath and beyond and all about the brightly illuminated spot which we ordinarily think of as consciousness there is a field, a twilight zone if you will, of what we call the unconscious, wherein the play of forces which we call motives, instincts, trends, drives, wishes have their sway, and an understanding of which is necessary to the understanding of man.

The difference between these recent occurrences and the revolution in our ideas of the cosmos which came about, for example, as a result of Galileo's observations and teachings, is that in the latter case they were received not only with incredulity but with antagonism, with fear, with hatred, and with a sense that the old order must be preserved at any price or disintegration and chaos would reign supreme in this world and disaster in the next. These new observations, however, have all of them come about as a result of scientific research with no great upheaval of opposing public sentiment and with, on the whole, all along the line a general acceptance of the observed facts as these facts were sufficiently verified. To my mind the most significant single feature of our civilization with its many advancing scientific frontiers is the comparative ease with which to day it is possible to break with tradition when tradition has ceased to serve us.

May I at this point remind you that the field I represent is the field of psychiatry, and that what I wish to do is to give you some little idea of how in this field we have broken with limiting and crippling traditions and as a result have come forth into a new world of thought and knowledge, and something of what we have found, something of its significance for an understanding of man as an integrator.

In the first place, I have suggested only that one of the main features of advance in the psychological field has been the discovery of a great field of mental activities outside of the field of conscious awareness, a region which is ordinarily termed the "unconscious" but which by analogy with the body structures I like to speak of as the "organ of the unconscious." In this field we have discovered many things, some of which at

least have been vaguely known for a long time but which now, upon rediscovery, receive a new lease of life and a greater understanding We have discovered man more truly as he really is rather than as we previously knew him, disguised by the veneer of civilization and culture We have realized the necessity of considering the origin and the historical background of man as he appears at present, and while this examination has not deprived man of his many excellent qualities, it has taught us that he has potentialities which in the past we have never wished to recognize, much less to dwell upon Above all, it has taught us that we are all kin in a much more concrete way than we had heretofore supposed, that our respective pasts are so long that our presents are inconsiderable as compared with them, and that this past is what we possess in common, in other words, that the differences by which we know one man from another, our friends from our enemies, people of different races, religions and languages—all these differences, the individual differences of the psychologists and these others, are inconsiderable as compared with our likenesses which have been laid down as permanent possessions as the result of millions of years of preceding life experience in conflict with a hostile environment, and that the reason that we are here to day is that by and large this struggle of life as it has pushed its way upward through the past eons of time has been a successful one because those results of experience which have had survival value have been somehow preserved Let me dwell briefly upon some of man s qualities as displayed by a search into his unconscious motives, and let me give some examples to illustrate what I mean

In the first place, it is essential from our point of view in questioning the organism to realize that those questions must be addressed to the organism as a whole rather than to some of its differentiated structures, and that what we need to know about are the purposes of the organism in the broadest possible terms and how these purposes are striven for and attained or missed, and it is only at the psychological level that these purposes manifest themselves with any clarity If we vision the organism battling with a hostile environment we can see that its most general purpose is to succeed in the battle, by which is meant to preserve its own life, to perpetuate the life of the species, and perhaps less important but nevertheless to be considered at least in the realm of human life, the gaining of some form of pleasure, happiness, satisfaction, self-expression as a result of the conflict —the seeking of pleasure and the avoidance of pain is the simple way of putting it In making this statement I have already differentiated two great regions the environment, or the world without, the most important component of which for man is his fellow men, and the world within, the mind, with its ideas, its feelings and its tendencies expressed through the body The conflict of the organism with the environment is a conflict that has its reflection or repercussion in the world within, so that as we expect antagonisms without so we must expect antagonisms within We are dealing here probably with a concept as generic in type as that of the energy concept at the basis of the law of action and reaction Life goes forward as the expression of conflict and continues as long as the balance is on the side of success

The reciprocal relation of the world within and the world without is the most significant feature to which I wish to direct your attention In the first place, it is fair to assume, as I already have, that in the history of man s development his successes should somehow be preserved The main features of the conflicts of the past have been the building stones with which he has scaled the heights, and so it is not strange that we should find the remnants and indications of these important events laid down in the structure of the mind as well as we see them laid down in the structure of the body We have the indications the bodily history preserved not only in the embryology of man but also in various developmental anomalies and peculiarities with which we are all more or less familiar There is as truly an anatomy and a physiology of the mind, represented by its structures and functions, as there is an anatomy and physiology of the body and there is as truly a genetic psychology as there is an embryology and there is as truly a paleopsychology as there is a paleozoology or a paleobotany As there are archaic structures in the body so there are in the mind, and when man comes to civilization he carries with him all these indications of his past at the psychological as well as at the somatic level So we see from this point of view that all the forces of the cosmos as they have been concentrated in the conflict between the organism and the environment have resulted in definite structures of mind and body which have been preserved, in miniature as it were, and give us the picture of an organism which at each moment is reacting with the precipitates of its entire past to the present situation These purposes of the organism as we see them represented when we look at it in this way orient us in an entirely different way towards the problem of man Instead of viewing him from a purely descriptive level there now inevitably come to the forefront meanings and values Life does not present simple, direct situations capable only of a single interpretation We are always torn between our instinctual tendencies, on the one hand, and the necessity for their adjustment in a satisfactory way to the situation as it exists at the

moment Here we are confronted with questions of choice, matters of judgment, and meanings and values are the deciding factors It is inevitable, therefore, as you see, that man's desires should come up against, as it were, all manner of obstacles in his environment, and that therefore his main objective in life must be to modify that environment, to bend it to his purposes, and in this way to bring to pass his desires Here we have at once an explanation of the growth of science, for science has this objective above all others, and not only that, but we have an indication as to why different individuals choose different careers, for it is because they each of them are different that they bring a different pattern of personality to bear upon their present problems and are driven to their choice by a necessity resulting from the clash of this different pattern with the forces with which it is in conflict So we have a right to suppose that the reason why a man becomes a chemist, why he becomes a physicist, why he becomes a biologist, are all questions that can reasonably be asked of the organism, and that we may expect to find answers to these questions in the make up of the individual concerned In fact, we may go still a further step and say that man's interpretation of his environment is dependent upon what he wishes to accomplish In other words, he interprets his environment dependent upon how he intends to react to it For example, a book to one man is something from which he may obtain certain information, to another man it is a volume which replaces one that has been lost and therefore completes a set, to another it is a beautiful thing which will look well in a certain bookcase, to another it is something to be reproduced by the processes of printing and binding, and so on—to each one the environment is perceived and apprehended in accordance with the ways in which he would act upon it and mold it to his purposes So that we see man coming to the problems of his life with the accumulations of the past and meeting them in accordance with the purposes which he desires to bring to pass That "man is the measure of all things" is therefore no longer just a phrase nor yet a commonplace, but is a fact of tremendous significance and importance and one that must fundamentally modify our way of thinking of him in all his different aspects You will see, therefore, that I think of man, an individual man, for example, as a point where at the moment the forces of the universe are nucleated in a particular way, and where they are working themselves out in accordance with certain laws Man is one of the products of the cosmos, he is not something which has been added to it, and therefore, as we might expect, he expresses within himself the laws which operate elsewhere in the cosmos The functions of mind can be thought of best in terms of energy, although at present we are unable to differentiate and separate this energy and measure it I can not, however, but feel with the author who says "Considering the impossibility of defining the exact line of demarcation between animate and inanimate matter, it is astonishing to find so much stress laid on the supposed fundamental difference between vital and non vital phenomena"[2] Man thus becomes the final integrator of all the laws, physical and vital, that have led up to his development and which he manifests in the very fact of living

Most physical phenomena, as I have already indicated, can be expressed in the framework of certain dimensions the large masses with which the astronomer deals, the smaller masses familiar to the physicist, the still smaller ones of the chemist, and then the world of the sub-atomic which is beyond the field of vision and in which still different laws seem at the moment to be possible, where perhaps cause and effect, as we generally know them, no longer rule, where the principle of indeterminacy takes the place of that of determination, then there is the so called 'world of neglected dimensions'—with which words the colloids have been referred to And then we get finally to the field of psychology in which dimensions as we ordinarily know them do not seem to be applicable in the ordinary sense, with the exception perhaps of the dimension of time Here we are dealing in a field that is quite unique, except that whatever occurs in this field occurs in accordance with the laws of the field Whatever finds its way into the psyche is governed by the laws of the psyche, but because it has those characteristics which defy measurement in the ordinary ways with which we are familiar it is quite probable that it may require modifications in methodology which will have to be developed in order to wrest from it its secrets, and in one respect this possible difference of methodology will have to be borne in mind, and that is in the old sense that man in order to understand himself is in the unique position of being both the observer and the observed He has, so to speak, to lift himself by his own bootstraps This has always been a vexatious, and, so far as I know, an unsolved problem It has been written of, thought of and argued, many suggestions have been made but none of them satisfying I only have this to offer in this peculiar situation in which man finds himself when he wishes to understand himself, and I refer to what I have already said about the way in which man perceives the universe about him, namely, in accordance with the plan of action which he intends to develop with reference to it, or, in the words of Bergson,[3] "our perceptions give us the plan of our eventual action on things"

[2] Stephane Leduc, "The Mechanism of Life"

By development, by history, from any way we look at the organism, it is essentially a going concern. Meanings are without significance except as they express themselves in actions. Perceptions are without significance unless ultimately action results from them. Our knowledge, so-called, of the world about us, is a knowledge which has developed and been organized for the purpose of our actions upon that world. If, therefore, we are content only to think about and argue about the difficulty man may have because he is both observer and observed, we will find ourselves with an unsolvable problem from which we can not extricate ourselves. If, on the other hand, we undertake to carry out the design on which we are built, if we yield to the demands of our structure, if we undertake to do something about these various problems, somehow there will be wrought through the strange alchemy of life results which will advance our knowledge and increase our effectiveness. While this may seem the best we can do it is not enough. We must not permit ourselves to be stalled into inaction by the sterilizing magic of words but must overcome such difficulties by attempting to solve the problems that life presents to us by doing something effective about them.

Now let me briefly indicate some of the more outstanding contributions that psychiatry has to make in regard to the principles I have outlined. I spoke of the reciprocal relations of the world within and the world without. It is quite understandable that when the world without is destroyed chaos should reign within the mind. At times of great catastrophes such as earthquakes, and especially, as we have seen in the world war, when enormous shells explode in the neighborhood of an individual, we find the result to be a feeling of utter helplessness as all the usual and familiar stabilities of the world disappear. The very earth itself trembles and no longer offers a stable foundation. The enormous destructiveness makes our lives so insignificant that complete annihilation seems imminent. Terror seizes the victim, and complete confusion reigns in what had previously been an orderly world. It is perhaps not so understandable, except in the face of an acceptance of the idea of reciprocal relationship that I have mentioned, that, when the world within is threatened by disease, when in fact as a result of progressive organic disease of the brain it undergoes a process of disintegration, under these circumstances such a process should be accompanied by delusions which we term nihilistic delusions and which are expressed by the patient in terms of the destruction of the universe. He feels that all things about him are crumbling away and disintegrating. He feels the apprehension, the fear, the confusion, which such a disintegrating universe forces upon him. And so he comes by a different route to the same net result reached by the individual in the midst of a great catastrophe.

On a par with these phenomena are the much more familiar symptoms that we find very frequently in the very early stages of mental disease. I refer particularly to the symptom that we call "depersonalization" but which is more commonly referred to as "confusion." In this state of mind the patient feels strange, as if something had happened to him. He is uncertain, acts perplexed. The feelings of strangeness may seem more particularly as if they applied to himself or to the world about him. He has lost the feeling of definiteness and security with which he contacted the world previously. He feels perhaps that he is not himself, he has lost his feeling of personal identity. These symptoms can be understood in the light of what I have just said about nihilistic delusions when it is realized that we think of psychoses as being, in the first place, a retreat from the world, and, in the second place, a distortion of that world. Therefore you will see that under these circumstances the patient who is moving into a psychosis develops as his first symptoms disintegrations of a mild degree of both the world within and the world without. There reciprocal relations maintain as they did in the more malignant situations referred to above. One does not change without the other.

In the face of these principles, too, it is not by chance that, in the conditions which we term "mental disease," the method of thinking, the forms and structure of the thought processes and actually to a considerable extent the very content of thought itself take on the characteristics of the thinking of children and of primitive peoples, for, after all, has not man passed through the period of childhood, both individual childhood and the childhood of the race, and is it strange that he should carry with him characteristics pertaining thereto? And when disease involves his mind we find that these characteristics appear as symptoms. This change is expressed by a movement in the direction away from the reasoning, differentiation and abstraction of highly developed thought processes toward forms of expression in which feeling, concreteness and perception dominate.[4] If we examine such an organic disease of the brain as aphasia in some of its forms we may rather unexpectedly find the same principle to hold. We have been so imbued with the localization theory of function of the last century that we are hardly prepared for such phenomena. We have been thinking of cortical cells as if they had only specific functions to perform and the

[3] "Creative Evolution."

[4] Alfred Storch, "The Primitive Archaic Forms of Inner Experiences and Thought in Schizophrenia."

destruction of these cells would result in the destruction of these very specific functions This concept is not by any means wholly wrong, but it is only a partial truth, for when we do get aphasias as a result of destructive processes of the brain we find that we do not have the simple dropping out of exceedingly concrete and well defined functions but a regression to a simpler way of expressing ourselves through the medium of language Perhaps no function illustrates better than language the fact that man is not the result of a process of simple addition in accordance with what I have described as the mosaic theory of structure Language like the simple reflex is by no means an isolated or rigidly circumscribed phenomenon As the reflex,' in the words of Coghill,[5] is in its genesis dominated by the total behavior pattern,' language is an expression not of a few closely related cortical brain cells but of the whole individual, and when the mechanism by which this function is translated into speech is interfered with this function as a whole drops to a lower and more primitive level consistent with the reduction in complexity and the simplification of the remaining available anatomical structures and physiological mechanisms Such examples as these might be multiplied indefinitely, but I have simply quoted these two to indicate how far flung are the possibilities of the interpretation of human behavior and the nature of man by way of the route of psychopathology

Let me reverse the direction of my thinking and, instead of speaking of what may accrue to the understanding of man by way of psychiatry indicate some of the things which the psychopathologist particularly the psychotherapist may hope for from the field of general science particularly biology In the experimental work of the biologist certain results have stood out in recent years which appear to have attracted little or no attention from those who are interested in modifying human beings by various methods of therapy I refer to the experiments which have been made in the modifications of animals by various changes in their environment Take, for example, the wide variations in appearance which have resulted in the same species of butterflies from living under different conditions of temperature and moisture, types of modifications which have been duplicated in various ways in the laboratory Think of the control of the sex in pigeons by causing their metabolic rate to vary Think of the modifications in the development of the claws of shrimp so that the large claw can be at will grown upon either the right or the left side, and the various monstrosities that can be brought to pass in the development of such animals as the fish by the modification of the chemical constituents of the solutions in which they grow and the arresting of development at different points And most astonishing of all are the transplantation experiments by which tissues transplanted from one region of a developing organism to another develop into the structure that would naturally be produced in this location What it becomes depends on where it is—its environment

Such results have served to change our way of looking at the problems presented by heredity and environment and we have come to begin to think of these two terms as what I call ambivalent opposites, as only two different aspects of the same process The significant thing is that when we have hereditary structures hereditary possibilities can only be realized in fact if the organism is exposed to the type of stimulus emanating from the environment which causes their development In other words a person may inherit a quality without ever showing any signs of it at all, simply because he has never been exposed to the proper stimulus Assuming that such a characteristic as ability to play the violin were transmitted by heredity it is understandable that an individual might inherit such an ability but never realize it because he never had a violin to play upon The significance of these experiments and this new point of view, I think, is very great for human beings for it means that as marvelous as the whole integrating process which has culminated in man has been throughout time resulting as it has in the concentration of all the possibilities of adult realization in submicroscopic packages of probably fairly definite chemical make up known as genes nevertheless these minute results of life's experience laid down in these forms can be conceived to have still greater possibilities than have ever been realized as the result of the sort of experiments I have indicated This all means that whereas our hereditary pattern is fixed to a certain extent, it is only fixed under conditions of life such as we ordinarily meet up with and that entirely different conditions might result in the realization of possibilities undreamt of A whole new field of possible therapeusis is opened up here, the value of which experiment and experience alone will determine The main point to be emphasized here is that the advance of science breaks down limiting traditions, and in this particular instance limiting traditions which are preserved by and imbedded in our language, for such a concept means nothing more nor less than that what is ordinarily recognized as constitution and generally thought of as unmodifiable is transferred to the category of acquired characters which can be changed by

[5] Individuation versus Integration in the Development of Behavior '

experience The supposedly irreversible has been found to be in fact reversible If this is so—and I merely put it forth as a hypothesis, then surely man may look forward to untold accomplishments in the future which he has a right to expect will equal or exceed those of the past, all of which is rendered possible by the fact that he presents to the world into which he is born a concentrated solution, as it were, of the possibilities of adjustment to the environment which he has acquired through the millions of years of the past experience of life, which possibilities are ordinarily only partially and inadequately realized

One of the characteristics of man which is exceedingly significant for this process of continuous adjustment is his very highly developed self regard In the old medieval universe in which he lived he was its center and all the rest of creation existed to minister to him and to emphasize his importance When the teachings of astronomy overthrew this geocentric universe man resented it tremendously and fought these ideas vigorously until, convinced against his will, he had to accept the facts, and then, in order to compensate himself for his loss of self esteem he began to acquire a knowledge of this universe, to master it in this way, and hence he became an astronomer When the theory of evolution threatened man's dominance among the animals he again resented being pulled from his pedestal, but when he had to accept these facts he reacted by the compensatory mechanism of mastering this new world in which he found he had to live, and he became a biologist When the more recent advances in the psychology of the unconscious demonstrated that each individual was just like everybody else, that we were all turned out of a common mold, that our past was of such infinitely greater significance than what we had acquired in our short lifetimes, that our personal and unique qualities were negligible, man again resented being merged with all his fellows, but when he had to accept this fact he began again to protect himself from the feeling of being at a disadvantage in this new world by mastering the facts of this new science, and he became a psychologist In each instance when his dominance by birth and position was threatened he compensated by learning to master reality by knowledge and thus reconquered his dominion but on a different plane And thus as time passes his possibilities constantly increase He becomes more highly differentiated, to be sure, but the significance and the value of his differentiations are dependent upon the original source of all energy, just as the blood supply of the tiniest capillary is dependent upon the reservoir of blood in the heart This reservoir makes him kin to the whole world and its existence expresses the fact of his capacity for accumulating unto himself, in miniature, the possibilities of his entire environment

This thesis, of course, might be carried out to almost any conceivable lengths The comparison of man's thinking, as it is reduced to more primitive levels, with the thinking of children and of primitive man, is full of interesting material We see our patients definitely expressing themselves in their behavior and their language by animistic mechanisms We are familiar with their beliefs in magic and in the super natural, and in the more malignant types of disorder there appear strange and weird forms in the content of thought which can only be likened in their archaic characteristics to the fossils we are familiar with in the field of paleontology Similarly, if we wish to develop our thought along the lines of what years ago Roux called his 'developmental mechanics,' I am sure we could find many illustrations at the organic level that would bear out what has been said The struggles between the different parts of the organism are as real as the intrapsychic conflicts and the principle evidently holds that the pattern of differentiation is dominated by the total pattern of the organism as expressed in such terms as Lashley has used, for instance, with regard to the central nervous system when he speaks of the equipotentiality of the brain cells, by which he means that aside from their specific functions they have certain general functions which we may conceive to have been the basis from which the specific have differentiated All these concepts assist us to an understanding of ourselves They enable us to appreciate the significance of the utter selfishness of the individual organism, of the aggressive tendencies which it is willing to utilize for its self aggrandizement and of the usually bewildering fact that an individual may hold two mutually exclusive opinions about the same question at one time without one seriously interfering with the other We can understand, too, why, for example, we find the psychiatrist writing about such concepts as time and space[6] which used to be considered exclusively matters for investigation by the physicist and speculation by the philosopher And, finally, we must appreciate that the peculiar constitution of man is his key to the understanding of nature or, perhaps it were better said to the understanding of nature as he comprehends it All of which is perhaps not especially new or startling, but its significance, to my mind, lies in the fact that no single scientific discipline, at least in the present century, has offered so much by way of promise in the solution of these vexatious problems as psychiatry It will remain to be seen how satisfactorily these promises will be realized in the future

[6] Paul Schilder, *Psyche*, 14 124, 1934

OBITUARY

DAVID WHITE

Dr. David White died at his home in Washington, D. C., on February 7, 1935.

Born in Palmyra Township, Wayne County, N. Y., on July 1, 1862, of early pre-Revolutionary stock, the youngest of a family of eight, he attended the country schools, prepared for college at Marion Collegiate Institute and entered Cornell with the class of 1886.

Botany was an early interest, stimulated by an inspiring teacher at Marion and maintained throughout his college career and later life. In his sophomore year he came under the influence of Samuel Gardner Williams, Charles S. Prosser and Henry S. Williams and thus acquired a sound training in general geology and paleontology. In the course of the field work of the classes in geology he made substantial collections of Devonian plant fragments in the vicinity of Ithaca. Because of his training in both systematic botany and paleontology, these fossils intrigued him and became the basis for the thesis then required for the B.S. degree at Cornell.

In the spring of 1886 Professor Lester F. Ward, in charge of paleobotanic investigations for the U. S. Geological Survey, appealed to Professor Williams for an assistant with training in paleontology and capacity for illustrative work. White, who had had some training as a draftsman and had illustrated his bachelor's thesis by new figures of much merit, was promptly recommended and as promptly invited to Washington to undertake, for the Geological Survey, the task of preparing illustrations for the use of Professor Ward. Thus began, in May, 1886, an official connection that was maintained with few interruptions until Dr. White's death, nearly 49 years later.

Ward's own interest, although very broad, was primarily in the fossil plants of the Mesozoic, and White early came to specialize in the practically unoccupied field of the Paleozoic. This field he soon made his own. His high reputation as a stratigraphic paleontologist rests primarily upon his studies of the Pottsville floras of the Appalachian province.

He revolutionized the preexisting concepts of the stratigraphic position of large portions of the Pennsylvanian section, particularly in the southern Appalachian region, and demonstrated that thousands of feet of beds in Alabama, Tennessee and Kentucky particularly, which had been regarded as much younger, were of Pottsville age. These conclusions, at variance with the positions then held by such authorities as I. C. White and J. J. Stevenson, nevertheless quickly won general acceptance, owing no doubt in large measure to the tactful, considerate and reserved but convincing way in which the young paleontologist presented his evidence.

So thorough and so detailed was White's work that he soon came to be the main dependence of the stratigraphers of the Federal and State Surveys who were working on the Pennsylvanian rocks of the Appalachian province—not only for the correlation of major divisions of the rock groups but even for the identification of individual coal beds from point to point.

It is difficult for any organization to keep its able specialists out of administrative activities, particularly if their interests are broad and their judgments sound. White suffered the usual fate and about 1907 was drawn into Survey administrative work, first as head of the Section of Eastern Coal Fields and later as chief geologist. He served in the latter capacity during the decade 1912–22. When at the end of this period, in response to his own repeated urgings, he was relieved of direct administrative responsibility, it was with the expectation that his personal research work could be immediately resumed, but there intervened a period of 3 years as chairman of the Division of Geology and Geography for the National Research Council before his desire could be realized. Meanwhile there had developed many calls upon his energies through various committee and advisory relations, formal and informal, with the National Academy of Sciences, which he served for 4 years as home secretary and for 2 years as vice president, so that even his return to research in 1925 was, in a measure, nominal.

Early in 1931 there came a serious physical breakdown, from which a partial recovery left his mental powers entirely unimpaired, although physical endurance was diminished. The last years have been dedicated, without diminution in either enthusiasm or ability, to work on deferred problems within his selected fields. Just a few days before the end he completed a manuscript on "Metamorphism of the Organic Sediments and Derived Oils," in which his great carbon ratio theory of a generation ago is reviewed and modernized.

To his close associates in the Geological Survey and the scientific organizations of which he was a member, Dr. White was always an inspiration. His enthusiasm and industry were unflagging, his knowledge encyclopedic. His personal and professional generosity knew no limits, and to the earnest younger student who sought his counsel he would devote time without stint, pouring out for the benefit of the neophyte a wealth of information and inspiration, of suggestion and advice, which constituted both a program for a scientific career and a guide to its attainment. Always generous in his judgments, his rare displays of impatience were reserved for the slacker or the careless and particularly for lapses in ethical standards. For these

he had no tolerance But even his condemnations, although expressed picturesquely and with fervor were couched in terms so humorous and so kindly as to convey the impression that their object was to be pitied rather than blamed

He never lost hope for any man, and indeed, within the sphere of his influence it was difficult for an associate to do less than his best, because it was so obvious that no less was expected of him

Along his pathway through life are hundreds of fellow men and women who have been helped to bear or to forget the burdens of life by his cheerful but adamant refusal to admit that there are any In his philosophy life consisted wholly of opportunities to be made the most of, never of limitations to mourn over How interesting and what fun it all was, and how particularly fascinating the career of science, constantly opening as it does new vistas of comprehension and understanding! His was the quenchless spirit of the inveterate explorer, as every leader in science must be, always eager to see what lay beyond the visible horizon and tremendously pleased as the new vistas opened He was too enthusiastically busy to waste time on anything so fruitless as introspection Given neither to underappreciation nor to over appreciation of self, he was wholesomely lacking in self consciousness and always looked outward and forward, never inward or back There was no resisting the infectiousness of his spirit

Both by the example of his own great and sound accomplishments and by his eagerness to see others attack the innumerable problems awaiting solution, he became an inspiration and a power in his generation

His was a proud spirit, but proud of simplicity, proud of integrity, proud of genuineness and independence and tolerance, never of place or power or trappings, and proud of reputation only as evidence that his own well based but unassertive self respect found support in the opinions of men

Despite an openness of character really possible only to those who have nothing to conceal, there were things about which he was disingenuous No one will ever know how many he has aided with funds—not easily, as the wealthy can, but only by the exercise of a generosity that was real because it meant personal sacrifice Still less will we know about the hundreds of younger associates whom he has counseled and encouraged and in whose way he has placed opportunities at the price of a limitless outpouring of his own energies

Like many geologists of his generation, Dr White did not lack opportunities to capitalize his abilities and his unique knowledge Although he never sought them, offers came to him to enter the commercial field at several times the modest salary which the government pays its scientific leaders These offers never tempted him Although he realized that there are men of vision in the modern industrial world who know that an untrammeled research staff is a wise investment, even measured by the profit standards that determine success or failure in business, he yet was unwilling to enter an environment motivated by profit as a main objective Although some of his own work had great economic significance, that was incidental to his research, and he preferred it so The choice lay between applying his talents at a large salary, primarily to profits for a restricted group, with research as an incidental by product, and applying them broadly, at a small salary, to the general service of mankind, with the economic results incidental There was never any hesitation on his part about the choice to be made He remained a government geologist until the end

As a geologist, Dr White is to be judged not of course primarily by the length of his bibliography, which may contain 200 titles, but by the diversity of the fields that he occupied and in which he wrote with authority He has long been the foremost Paleozoic paleobotanist on this continent and perhaps in the world His work in this field was not merely soundly systematic and descriptive but was interpretative from the beginning He was a stratigraphic paleontologist of the highest rank He was our foremost authority on the origin and evolution of coal His great generalization, known widely as the carbon ratio theory, was an outgrowth of his studies on the origin and evolution of both coal and petroleum It established a "dead line' beyond which oil pools will not be found and thus has great economic significance It alone stamps him as a rare original investigator and thinker He contributed significantly in the field of isostasy and during the world war he administered an important unit of government in such fashion as to make it most useful in the crisis

Happily Dr White received during his lifetime gratifying recognition of the high place that he held in the esteem of his fellows He became vice president of the National Academy of Sciences after long service as its home secretary He was president of the Geological Society of America Three of our leading universities honored him with doctorates Two of the principal medals of the National Academy were bestowed upon him He received the Penrose Medal of the Society of Economic Geologists and the Boverton Redwood Medal of the Institute of Petroleum Technologists of London He was an honorary member of the geological societies of Belgium and China

Thus his years were as full of honors as were his days of activity His was a career that came to full

and happy fruition His last day was a busy and a cheerful one Before the dawn of the next he went quietly to sleep

W C MENDENHALL

RECENT DEATHS

DWIGHT PORTER, emeritus professor of hydraulic engineering at the Massachusetts Institute of Technology, died on February 26 He was in his eightieth year

WILLIAM HALE HERRICK, retired professor of chemistry at Pennsylvania State College, died on February 26 He was eighty five years old

DR CLEOPHAS C O'HARRA, professor of geology and president of the South Dakota State School of Mines, died on February 21 at sixty eight years of age

HENRY EDISON PHELPS, research engineer with the American Telephone and Telegraph Company from 1917 to 1934 and with the Bell Telephone Laboratories since March, 1934, died on February 21, at the age of forty one years

DR. HERBERT A PULLEN, past president of the American Society of Orthodontists and a former dean of the University of Buffalo, died on February 17

DR ARTHUR THOMSON, emeritus Dr Lees professor of anatomy at the University of Oxford, died on February 7 at the age of seventy six years He was distinguished for his work as an anatomist and as a physical anthropologist

PROFESSOR WALTHER SPIELMEYER chief of the division of neuropathology in the Forschungsanstalt fur Psychiatrie in Munich, died on February 8

SCIENTIFIC EVENTS

THE THREE HUNDREDTH ANNIVERSARY OF THE FOUNDING OF CHEMICAL INDUSTRIES IN AMERICA

APPOINTMENT by the Manufacturing Chemists Association of a committee to cooperate with the American Chemical Society in celebrating in New York during the week of April 22 the three hundredth anniversary of the founding of the chemical industries in America has been announced

The members are F M Allen, president of the Mathieson Alkali Works, Lammot du Pont, president of E I du Pont de Nemours and Company, and George W Merck, president of Merck and Company

Science and industry will join in an exposition of chemistry's development since John Winthrop, Jr, first colonial governor of Connecticut, in 1635 mapped out a far reaching program for the production of salt, iron, glass, potash, tar, black lead, saltpeter medicines, copper alum and other chemicals

Dr Arthur W Hixson, professor of chemistry at Columbia University and chairman of the general committee of arrangements, reports that at the tercentenary assembly, to be attended by more than 10,000 representatives of chemistry and allied sciences, Winthrop will be heralded as the real founder of the nation's chemical industries

Inventions, discoveries and explorations in chemistry over the span of 300 years will be traced to show how infant industries have become the bulwark of national defense, the basis of modern industrial progress and the source of a large and growing percentage of national wealth

Senator Pat Harrison of Mississippi and Representative James W Wadsworth of New York will be among the speakers at a dinner meeting on Wednesday evening April 24 On the same day a chemical industries symposium, planned to interpret the close relationship between the chemical industries and the national welfare, will be held Thomas Midgley, vice president of the Ethyl Gasoline Corporation, will deliver an address on Chemical Developments in the Next One Hundred Years William B Bell, chairman of the board of directors of the American Cyanamid Company, will speak on National Planning and the Chemical Industries"

Other themes at this symposium include What the American Chemical Industries Have Done and Are Doing for the Nation', New Foreign Problems Confronting the American Chemical Industries', Scientific Foundations of the American Chemical Industries"

On Thursday, April 25, there will be a symposium on the economic problems of the chemical industry, with R P Soule, chemical economist of the Tri Continental Corporation, as chairman Machine Age or Material Age?' is one of the topics to be discussed

The rise of the process industries in the post war decade will be described, the discussion centering around synthetic fuels, building materials, rubber wrappings, the encroachment upon agriculture and the products of the farm, the realignment of industries and the outlook for the future

Depreciation and obsolescence charges under the New Deal will be another theme of this symposium The chemical industry, according to the announcement, is outstanding in high charges for depreciation and obsolescence The chemists will discuss federal policy toward reducing corporate surpluses and increasing tax revenues, and will explain their attitude

toward current and past depreciation and obsolescence reserves

The question of chemical prices will also come up, the discussion involving the trend of typical prices against the background of the general price structure below both 1914 and 1926 levels A protective tariff, according to the announcement has not increased prices, low prices resulting in spite of high wages Other problems to be dealt with include prices vs earnings, trend of prices in the future, elastic and inelastic markets for chemicals

A third symposium will be devoted to materials of construction in the building industry The chairman will be Professor James R Withrow, of the Ohio State University A group of papers will outline the latest developments in new materials of construction important to the chemical industries These papers will cover a wide range of materials, including metals, ceramics, plastics, rubber and alloys

Sessions are scheduled by the nineteen professional divisions of the American Chemical Society On Tuesday evening April 23, the William H Nichols Medal of the New York Section of the American Chemical Society will be bestowed upon Father Julius A Nieuwland of Notre Dame University

Numerous allied organizations, industrial and scientific, are aiding in the plans for the tercentenary events Among them are the Synthetic Organic Chemical Manufacturers Association and the chemical societies of the metropolitan district

THE BANTING RESEARCH FOUNDATION

THE work carried out under grants from the Banting Research Foundation during the past year is reported by the secretary to have been very satisfactory Further, during the year reports and printed papers have been received from workers whose grants terminated during the year 1932–33 As a result, the secretary is able to report that 20 papers have been published during the past year and several are in preparation or have been submitted for publication The number of printed papers would have been increased had not the depression led editors of scientific journals to refuse three or four papers on account of their length, or the necessity of a larger number of illustrations than their funds allowed them to accept This difficulty has shown itself most acutely in regard to the grants made for the study of the racial factor in labor by Dr Cates, representing the committee in charge, and Dr Goodwin One paper in this series has now been accepted and there is hope that others will also appear during the next year

Papers published during the year include that of Dr A C Abbott, of the University of Manitoba, whose paper on constriction of the trachea confirms and extends the work of Breitner and others on the effect of oxygen restriction on the thyroid gland, that of Dr J Beattie and P R MacDonald of McGill University, which forms an important contribution to the physiology of the lachrymal gland, Dr Maurice Brodie of McGill University whose seven papers on infantile paralysis led up to his work on treatment which is attracting wide spread interest, Dr A M Davidson, of the University of Manitoba, in five communications on fungus diseases of the skin, contributed much to our knowledge of these diseases, their animal hosts and their treatment Dr R D H Heard and Dr A D Welch of the University of Toronto showed that ascorbic acid was the substance which prevented the oxidation of epinephrine in adrenal perfusates This work also opened up a field of study in the oxidation reduction changes in the body, which had not been previously explained Dr R F Shaner of the University of Alberta published two interesting studies of the embryological development of the eighth nerve nuclei Miss Armine Alley, of McGill University published three papers dealing with the mechanism of gastric secretion and with the treatment of hyperacidity

The grant made annually under the second clause of the foundation's charter to Sir Frederick Banting for the working of the department of medical research of the University of Toronto was also productive of much valuable work and some thirteen papers Several of these dealt with the biochemistry of silica in the body others with the phospholipids and glycerophosphates, their enzymic hydrolysis and the type of phosphoric esters in malignant tissues To these studies Dr F J King, M E Dolan H Stantial, A R Armstrong J J Rae J Fallon, D A Irwin and E L Outhouse contributed, while H J Perkin contributed a paper on the determination of iodine in the blood

THE ROTHSCHILD COLLECTION OF BIRDS AT THE AMERICAN MUSEUM OF NATURAL HISTORY

THE Rothschild or Tring collection of birds is now being prepared for classification and exhibition at the American Museum of Natural History under the supervision of Dr Ernst Mayr associate curator of birds It was acquired from Lord Rothschild in London in 1932 and was presented to the museum in memory of Harry Payne Whitney by his family, but was never unpacked because of inadequate facilities for storage and display However, the Whitney Wing, made possible by a gift of $750,000 from Mr Whitney in 1929 and matched under the terms of the gift by an equal sum from the city of New York, has recently been completed, and in this wing part of the collection will be exhibited, while part will be stored in 52,000 drawers as a study collection The collec-

tion, probably the most important and the largest private collection in the world, contains about 280,000 specimens, including 55,000 birds of North and South America and 25,000 sea birds

According to the *New York Herald Tribune*, Dr Robert C Murphy, curator of oceanic birds at the museum, who supervised the sorting, indexing and packing of the birds in England, states that by the acquisition of the Tring collection there are added to the museum collection birds of Europe, Asia and Africa, the Indo Malayan and Melanesian districts, Australia and New Zealand, a large proportion of extinct species from many localities and many very valuable hybrids and aberrant forms of numerous families, in which Lord Rothschild always took a special interest

The Tring collection contains many genera not, up to the present, represented in the American Museum, it gives also a relative wealth of species, known heretofore only from unique specimens Types—specimens that is, the particular skins on which the original description of species or races are based and which therefore serve as the standard of comparison—number about 3,000 Among the rarities are a great auk, two Labrador ducks, and a series of passenger pigeons and Guadalupe caracaras More important scientifically than these, however, are the remarkable aggregation of birds of paradise, including all but four or five of the known species as well as several extraordinary hybrid forms, collections of Hawaiian honey creepers and Old World sunbirds and the 6,000 American humming birds

Aside from the rarities, historic specimens and birds of gorgeous plumage, the greatest resources that the Tring collection offers to ornithology in America lie in the series of entire Old World families and lesser groups, which, by comparison with American groups, impart new meaning to the subjects of evolution and geographical distribution It is invaluable from a taxonomic standpoint

THE ANNUAL MEETING OF THE AMERICAN PHARMACEUTICAL ASSOCIATION

THE American Pharmaceutical Association and affiliated organizations will meet in Portland, Oregon, from August 5 to 10, with the Hotel Multnomah as headquarters The North Pacific Branch of the association will have direct charge of arrangements for the meeting under the supervision of the local secretary, Dean A O Mickelsen, of the North Pacific College of Pharmacy Portland, and with the active cooperation of committees representing the pharmacists of Oregon, Washington, Idaho, California and Montana This is the first time that the association has met in this section and every effort is being exerted to make it an outstanding event

The Pharmaceutical Associations of Oregon, Washington and Idaho will hold their annual meetings, jointly, in Portland on Monday and Tuesday, August 5 and 6 The Plant Science Seminar and the National Conference on Pharmaceutical Research will hold their annual meetings during the previous week, the latter on Saturday, August 3 The National Association Boards of Pharmacy and the American Association of Colleges of Pharmacy will hold their annual meetings, as usual, on Monday and Tuesday, August 5 and 6

The sessions of the American Pharmaceutical Association, including those of the Conference of Pharmaceutical Association Secretaries and of the Conference of Pharmaceutical Law Enforcement Officials, will be held on Wednesday, Thursday and Friday, closing on Friday evening

A joint banquet for all groups, including those attending the state association meetings, is scheduled for Tuesday evening, August 6 On Saturday, all visitors will be taken on an all day trip by bus, over the Columbia River Highway, during which an outdoor luncheon will be served Other entertainment features will be scheduled during the week and every opportunity will be provided to see the many unusual points of interest The arrangements for the various business sessions and the entertainment features will be announced as they are completed

The American Chemical Society will hold its summer meeting in San Francisco during the week of August 19, which will be convenient for those who wish to attend both meetings

Portland has ample hotel facilities for the convention The Hotel Multnomah will be given over to the business sessions and entertainment of the delegates and visitors to the American Pharmaceutical Association and related organizations The headquarters of the state associations will be located in other hotels within easy access to the Multnomah, so that visiting will be easy

The committee on transportation of the American Pharmaceutical Association will soon make an announcement in reference to rates and time The certificate plan will not be necessary because of the unusually low round trip or single rates, including choice of routes and full stop over privileges Special train accommodations will be offered from Chicago and other points, and a variety of interesting side trips will be available

THE ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF PHYSICAL ANTHROPOLOGISTS

THE annual meeting of the American Association of Physical Anthropologists will be held at the Wistar Institute of Anatomy and Biology, Philadelphia,

from April 25 to 27, with headquarters at the Bellevue Stratford Hotel

The tentative program is as follows On April 25 the afternoon session will be devoted to the reading of papers and the first business session, including reports of officers and standing committees and the introduction of new business, in the evening there will be a public address on a topic of general interest, on April 26 the morning session will be given over to the reading of papers, and in the afternoon the report of the committee on the international standardization of anthropometric methods, of which Dr Aleš Hrdlička is chairman, will be presented and discussed There will also be a discussion by Dr Raymond Pearl on biometric methods in anthropology in the evening, the annual dinner will be held with Dr Milton J Greenman, director of the Wistar Institute, as toastmaster, on April 27 there will be reading of papers at both sessions and the final business session will occur Members of the association will be guests of the Wistar Institute at lunch on April 26 and 27

Members who wish to present papers at this meeting should notify Dr Raymond Pearl 1901 East Madison St Baltimore, Md, as soon as possible giving name and institution, title of paper, time required for presentation whether or not it is to be given with lantern slides charts or other illustrations, and a non technical summary of not more than 500 words Those offering more than one paper should indicate which they prefer to present in case the program is crowded and which may be read by title The complete program will be announced early in April

SCIENTIFIC NOTES AND NEWS

DR CHARLES SIDNEY BURWELL professor of medicine at the Vanderbilt University School of Medicine, has been appointed dean of the faculty of medicine and research professor of clinical medicine at the Harvard Medical School to succeed Dr David L Edsall, who announced his retirement two months ago The appointment becomes effective in September Dr Cecil Kent Drinker, professor of physiology and acting dean, has been appointed dean of the School of Public Health in succession to Dean Edsall

THE medal founded by the Wilhelm Roux Stiftung fur Entwicklungsmechanik in commemoration of Wilhelm Roux, who died in 1924, has been awarded to Dr Jan Boeke, professor of histology in the University of Utrecht, for his research work on the development of the nervous system

THE council of the Institution of Naval Architects has awarded the Gold Medal for the year 1934 to Vice-Admiral Y Hiraga, professor of naval architecture and applied mechanics in the University of Tokyo, for his paper on 'Experimental Investigations on the Resistance of Long Planks and Ships and the premium to Professor B P Haigh, of the Royal Naval College Greenwich, for his paper on "Further Tests and Result of Experiments on Electrically Welded Joints in Ship Construction" According to *Nature*, the medal and premium will be presented at the opening of the annual general meetings on Wednesday, April 10, at the Royal Society of Arts in London

THE Chadwick Gold Medal and Prize of £100 was presented on February 18 to Colonel W P MacArthur, deputy director general of the army medical services at the British War Office and formerly consulting physician to the British army This award may be made once in five years to the medical officer of the British navy, army or air force who has most distinguished himself during that period in promoting the health of the men of the service to which he belongs

PROFESSOR STEPHEN TIMOSHENKO of the engineering mechanics department at the University of Michigan, has been appointed Hitchcock professor at the University of California

DR C LADD PROSSER research associate in physiology at Clark University has been appointed assistant professor of physiology

LESLIE WHEELER a member of the board of trustees of the Field Museum of Natural History, has joined the scientific staff of the museum as associate in ornithology He has been assigned facilities for active research work in connection with the collections of birds of prey

DR MATARO NAGAYO, professor of pathology and dean of the medical faculty, has been made president of Tokyo Imperial University

DR FERNANDO OCARANZA director of the faculty of medicine at the University of Mexico, has been appointed president of the university

THE board of management of the London School of Hygiene and Tropical Medicine of the University of London has appointed Sir Cooper Perry to be its chairman for the current year

DR. L RUZICKA, professor of chemistry at the Technische Hochschule, Zurich, Switzerland, will be a visiting professor in the department of chemistry

at the University of Chicago during the summer quarter of 1935 Professor Ruzicka will give two series of lectures, one on "Special Topics in the Chemistry of Alicyclic Compounds and the Terpenes," the other on "Selected Topics of Biochemistry"

DR SIMON FLEXNER director of the Rockefeller Institute for Medical Research, returned on February 25 from a visit to Egypt

DR HARRY L SHAPIRO associate curator of physical anthropology at the American Museum of Natural History, returned on February 26 after spending four months with the Templeton Crocker expedition to the South Seas during which he made a population study in the Marquesas and racial studies on Pitcairn and Easter Islands

DR EMIL F GUBA assistant research professor of botany at the Massachusetts State College, has been granted a six months leave of absence, to become effective on April 1 Dr Guba who is stationed at the Waltham field station plans to spend most of his leave studying and writing a monograph at Harvard University

DR STEPHEN JAROSZ of the geographical institute of the Jagiello University in Krakow, Poland will begin early in March a study of the geography, botany and forestry of four islands near the coast of Alaska

DR GEORGE C BRANNER state geologist for Arkansas has been elected president and Dr Arthur Bevan, state geologist for Virginia secretary of the Association of American State Geologists for 1935 Dr Raymond C Moore state geologist for Kansas and professor of geology and paleontology at the University of Kansas, has been made a member of the executive committee

THE Eastern States Archaeological Association held its annual meeting on February 23 at the Rochester Museum of Arts and Sciences, with the president, Colonel L M Pearsall, presiding Arthur C Parker, William C Ritchie and others of the Rochester Museum staff read a series of papers on the field work of the museum's recent excavations at Alima and Canandaigua

A JOINT meeting of the Society of Chemical Industry, the American Chemical Society, the Electrochemical Society and the Societe de Chimie Industrielle was held on March 8 at the Chemists' Club, New York A paper on "The Combustion of Coal as a Problem in Chemical Engineering" was given by Stephen P Burke, director of the industrial science division of West Virginia University

THE results of research in dentistry during the past year were described before the Baltimore section of the International Association for Dental Research on February 27 Dr E V McCollum, of the School of Hygiene and Public Health of the Johns Hopkins University, presided

AT the annual general meeting of the Royal Astronomical Society, held on February 8, the following officers were elected *President*, J H Reynolds, *Vice Presidents* Professor S Chapman, Dr H Spencer Jones, Dr H Knox Shaw, Professor F J M Stratton, *Treasurer* Sir Frank W Dyson, *Secretaries*, W M H Greaves and Dr W M Smart, *Foreign Secretary* Professor Alfred Fowler

DR JAMES R ANGELL, president of Yale University, recently gave the Elihu Root lecture of the Carnegie Institution of Washington His subject was "Popular and Unpopular Science"

DR JOEL H HILDEBRAND professor of chemistry at the University of California, spoke on "Solubility" at the dinner meeting of the southern section of the American Chemical Society in Los Angeles on March 1

THE twelfth Sedgwick Memorial Lecture was given on January 25 at the Massachusetts Institute of Technology by Dr J B S Haldane, professor of genetics at the University of London and head of genetical research at the John Innes Horticultural Institution who spoke on "Some Problems of Mathematical Biology"

LECTURES under the auspices of the American Entomological Society and the Philadelphia Microscopical Society were given at the Academy of Natural Sciences of Philadelphia on February 28 by Dr W Dwight Pierce, a member of the academy staff, and Dr David H Wenrich, professor of zoology at the University of Pennsylvania, on the transmission of human diseases by insects

THE University of Rochester held its fourth annual Sigma Xi day on February 22, with Dr George Boas, professor of philosophy at the Johns Hopkins University, as the principal speaker His subject was "Science and Metaphor" A morning science lecture for young people on "Corals and Cannibals" was given by Dr J Edward Hoffmeister, professor of geology at the University of Rochester During the afternoon a series of lecture demonstrations was given by Dr Joseph L Boon, of the Eastman Kodak Company, Dr Bradford Noyes, of the Taylor Instrument Companies, and Drs G P Berry, I A DuBridge, H C Hodge and E O Wiig, of the University of Rochester

DR ALEXANDER SILVERMAN, head of the department of chemistry at the University of Pittsburgh, will lecture before the southern sections of the Ameri-

can Chemical Society on "Glass An Indispensable Factor in Modern Civilization The schedule follows March 19, Lexington section Lexington Kentucky, March 20, East Tennessee section, Knoxville March 22, Georgia section, and Georgia Academy of Sciences, Atlanta March 23, Alabama section Birmingham, March 25, Louisiana section New Orleans March 27, Florida section, De Land, March 30, Virginia section and Hampton Roads Chemists Club at the College of William and Mary, Williamsburg

ON January 19 Dr W F G Swann, director of the Bartol Research Foundation, delivered an address before the Ohio State chapter of the Society of the Sigma Xi on the subject 'Nuclear Phenomena and Cosmic Rays This was the first of a series of lectures being sponsored by Sigma Xi at Ohio State University on the general subject The Nucleus of the Atom and Its Structure Professor M L Pool Ohio State University, on February 28 spoke on Methods, Energies and Products Involved in Nuclear Disintegration and Synthesis The remaining lectures in the series with their dates are as follows March 28 Professor H L Johnston, of the Ohio State University Deuterium as a Tool for Research in the Physical and Biological Sciences April 30 Professor E O Lawrence, of the University of California, Artificial Radioactivity , May 10, Professor G Gamow, visiting professor at the George Washington University, 'Nuclear Transformations and the Origin of the Chemical Elements

DR R COURANT, visiting professor from Germany, who is now at New York University, was the speaker at the meeting of the mathematics section of the New York Society for the Experimental Study of Education at Columbia University on March 2 His topic was The Teaching of Mathematics and Physics '

THE committee on scientific research of the American Medical Association on February 17 awarded grants to Dr Phillips Thygeson, assistant professor of ophthalmology at the State University of Iowa, for the study of trachoma and inclusion virus disease of the genito urinary tract to Dr W J Nungester, assistant professor of bacteriology at Northwestern University Medical School, for a continuation of studies on experimental lobar pneumonia, to Dr Willard O Thompson, assistant clinical professor of medicine, Rush Medical College, University of Chicago, for research on the effect of enzymatic digestion on desiccated thyroid, and to Dr Royall M Calder for research on the mechanism of inflammation in pneumococcus infections

A METAL industries exhibition will be held in the Commercial Museum, Osaka, Japan, from May 10 to 31 under the joint auspices of the *Journal of Metals* and the *Daily Industrial News*

A DAVID ANDERSON BERRY Gold Medal together with a sum of money amounting to about £100, will be awarded in July, 1935, by the Royal Society of Edinburgh to the person who, in the opinion of the council, has recently produced the best work on the nature of x rays in their therapeutic effect on human diseases A similar award will be made every three years

THE twenty third annual meeting of the Eugenics Research Association will be held at the American Museum of Natural History New York N Y, on Saturday June 1 All persons who have papers to present should indicate their intentions by letter as on as possible and the paper itself, with a 250 word abstract should be forwarded to the secretary of the Eugenics Research Association Cold Spring Harbor, Long Island, New York not later than May 10 Papers will be limited to twenty minutes and must be presented in person Lantern, blackboard, chart wall and exhibit space will be provided at the meeting

THE United States Civil Service Commission has announced open competitive examinations for the positions of junior physicist, chemist, senior, associate and assistant chemists The entrance salary for junior physicist is $2,000 per year subject to the usual deductions, for chemists, $2 600 to $4 600 Optional subjects for the examination in physics are electricity, heat mechanics and optics Vacancies for chemists exist in the Food and Drug Administration, Department of Agriculture, Dental Alloy Laboratory, National Bureau of Standards and Department of Commerce All applications must be on file with the commission at Washington not later than April 8

THE American Association of Anatomists has been requested by the Anatomical Society of Great Britain and Ireland to consider at this time, with a view to international agreement, a revision of the standard terminology of human gross anatomy (the BNA), which has been in use in American text books since its original adoption in 1895 For this purpose a committee has been appointed, under the chairmanship of Dr C M Jackson, professor and director of the department of anatomy at the University of Minnesota The committee has undertaken a general consideration of the problem and is studying both the British proposal and another suggested revision prepared by a committee of the German Anatomische Gesellschaft For the benefit of those interested in solution of the problems involved in revising anatomical nomenclature, a triple list of the BNA and the British and German revisions, in parallel, has been

prepared A limited number of copies are available for general distribution, and may be obtained without charge from the Secretary of the American Association of Anatomists, Professor George W Corner, The University of Rochester School of Medicine and Dentistry, Rochester, N Y

DISCUSSION

COAL AND NATURAL OIL IN THE PITTSBURGH REGION

ATTENTION should perhaps be called to a statement in an article by Dr Berl, entitled 'The Origin of Natural Oil,"[1] in which the author says "The presence of bituminous coal and oil in the same localities, but in different strata, for instance near Pittsburgh, forces one to the point of view that both substances were formed from the same material '

The horizons in which coal and oil respectively, are found in the Pittsburgh region are so far removed from each other geologically that their geographical agreement must be viewed as irrelevant in any discussion of their origin

The various coal seams lie in the Lower and Upper Coal Measures (Pennsylvanian) and the Upper Barren Series (Permian) whereas the oil bearing sands are in the Subcarboniferous (Mississippian) and the Upper Devonian The conditions under which the material of the coal beds accumulated, the origin of which is obvious, were very different from those which prevailed throughout the Upper Devonian and Mississippian, in the Pittsburgh region There is total absence of evidence of swamps such as contributed material for the coal seams, in the deeper lying strata where natural oil is stored

Whatever may have been the origin of natural oil, the fact that oil and coal happen to occur in the latitude and longitude of the Pittsburgh region has no bearing on the question

EDWIN LINTON

UNIVERSITY OF PENNSYLVANIA

DISTRIBUTION OF PAPERS IN BIOLOGICAL SCIENCES FOR THE PAST EIGHT YEARS

THE summaries of researches in biology that appear in *Biological Abstracts* make it possible to determine fairly well the degree of research activity in various divisions of biology While the editors of *Biological Abstracts* warn that it is not yet possible to cover all biological research papers published the world over and that a group of journals known to contain biological research can not yet, for one reason or another, be covered, this probably does not substantially affect the numerical relations between the various subjects discussed below

My class in theoretic biology was assigned the job of determining the number of papers reviewed in *Biological Abstracts* during the entire period of its publication since 1927, i e, about eight years The total number enumerated by us was 169,744 Of all the categories of papers classified in the table of contents we chose twenty two groups We did omit a few sorts of papers We listed in one group all papers concerning animal physiology which is made up of twenty sub groups We similarly combined sub groups of papers having to do with economic entomology and treated others likewise We combined plant and animal paleontology into one group This last named grouping might be criticized because the reviews in paleozoology in the *Abstracts* are general papers only, since systematic and morphological papers appear elsewhere

We determined the number of papers in each of the twenty two groups, found the total for each year, and then the percentage of each group of the total for that year We then charted the variation in numbers of papers in each group for the entire eight years, but the results of this charting are not presented at this time We also averaged the percentages of each group for the entire eight years The results of this computation are graphically represented in Fig 1, which also includes the percentage averages just referred to

It should be remembered that, due to at present unavoidable difficulties, abstracts of papers are published a number of months after original publication Systematic zoology holds first place in numbers of papers abstracted and indicates greatest activity, the total being about 38,000 Thus one of the oldest and most fundamental of biological sciences is still very much alive Next in degree of activity is animal physiology Nearly half of all papers reviewed are more or less directly related to the well being of man These groups are animal physiology, animal pathology, bacteriology, economic entomology, immunology and pharmacology May this be interpreted as indicative of the practical tendency of pure science?

We did not attempt to weight the scientific value or importance of the papers, since we did not consider ourselves wise enough to do so After all, would it be possible to appoint a board of judges who would give a worth while verdict as to the relative value of this or that investigation? Would an endocrinologist regard work in systematic botany as important as his own? Some might view investigations in physiology that would reduce the mortality of babies as of great value Others, thinking of difficulties that await the same babies when grown to adult life, might

[1] SCIENCE, 81 2088, 18, January 4, 1935

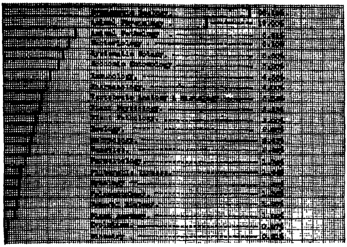

FIG. 1. Distribution of papers reviewed in *Biological Abstracts* from Vol. 1, 1927, through Oct., 1934, Vol. VIII.

regard the same investigations in an entirely different light.

And what about evolution? Papers dealing exclusively with evolution are surprisingly few. This situation may possibly cheer up the fundamentalists—or are there fundamentalists to-day? It *is* true that certain papers in experimental genetics and taxonomy discuss aspects of evolution which is not their main purpose. Is it not a fair conclusion to state that although biologists do not at all regard the evolution problem as solved, yet they evidently are not much interested in it? Is it because working in physiological fields "pans out" better?

Biometry appears to be in a state of real *depression!* According to our determinations, biometry occupies last place. At about the beginning of the present century there was great enthusiasm for biometry as a tool for measuring evolution. *Biological Abstracts* covers five or six journals devoted wholly to biometry of statistical methods but does not attempt to include many others, as for example those in which actuarial material is dominant. Nor do we find reviews of statistical papers which purport to demonstrate expectations of rise in stock values!

It must be exceedingly difficult to classify in existing categories some types of papers. Whether we wish to call it evolution or not, there is constant change in *styles* of investigations. For example, there is a place for papers in embryology and a place for papers in physiology. But at present there is considerable activity in the physiology of developmental phases. Difficulty in assigning papers such as these will continue because the biological sciences constitute a growing and changing body of knowledge.

Finally, it might not be amiss to acknowledge the debt biologists owe to *Biological Abstracts*, a truly democratic enterprise of the Union of Biological Societies. Its value will tend to increase in geometrical ratio as the years of its publication accumulate.

GEO. G. SCOTT

COLLEGE OF THE CITY OF NEW YORK

LABUAN, BORNEO, A NEW LOCALITY FOR THE WHALE SHARK

ON March 29, 1934, while working at the office of Dr. W. Birtwistle, director of fisheries for the Straits Settlements and Federated Malay States, at Singapore, the captain of a coasting vessel came in for information. He had with him the picture and dimensions of a very large fish which he had seen at Labuan a few days before. No one there knew the fish, but I recognized it at once as a fine typical example of *Rhineodon typus*, the whale shark. The specimen was 25 feet long.

Labuan is a small island on the northwest coast of Borneo, and gives us a new locality in plotting the distribution of this great fish. I had previously recorded the occurrence of the whale shark at Darvel Bay, on the northeast coast of British North Borneo, and had predicted its occurrence along the coast of the whole northern half of Borneo. The Sulu Sea is evidently one of the favorite haunts of this enormous fish, for we now have many records of its occurrence in all parts of the Philippines contiguous to the Sulu Sea. These records go back over a hundred years. Since the shores of North Borneo are laved by the Sulu Sea we may look for the whale shark anywhere in that region.

I have no doubt that Rhineodon is equally common in the Celebes Sea, which is connected by broad deep passages with the Sulu Sea. It may therefore be expected all along the north coast of Celebes and eastward along the north shore of New Guinea. Young whale sharks, up to a length of ten meters,

blunder into narrow straits and inlets and explore bays where they readily fall victim to the intricacies of the native baklad or fish corrals Inquiry among the Malay fishermen often reveals the capture of whale sharks in fish corrals at various times in the memory of the older men

ALBERT W C T HERRE
STANFORD UNIVERSITY

SCIENTIFIC BOOKS

PARENTHOOD

The Twilight of Parenthood By ENID CHARLES W W Norton and Company, New York Pp vi + 226 $2 50

THERE have been three main periods in the history of opinion on population problems In the first there was general and somewhat naive agreement with the Psalmist that children are like arrows in the hand of a giant, happy is the man who has his quiver full of them—in short, that increase in population is always desirable In 1798 Malthus ushered in the second period by pointing out that the potential reproductive capacity of mankind is quite capable of outrunning the means of subsistence, and for more than a century afterwards the dominant note among writers on the subject was the fear that overpopulation would reduce mankind to misery It is true that since about 1870 the birth rate in most European countries has been declining, but as the death rate also declined population kept on increasing and the era at which it would outrun the means of subsistence seemed merely deferred In 1925, however, Dublin and Lotka pointed out that a decline in the birth rate results in a larger proportion of women in the child bearing ages than in a stable age distribution and that consequently if the decline in the specific birth rates at ages were arrested the crude birth rate would continue to decline until the stable age distribution was reached On the other hand, with constant death rates at ages the crude death rate would increase, so that a population which was actually increasing would ultimately with the same specific birth and death rates become stationary or even decrease The United States, they found, was close to this potentially stationary condition in 1920, and Kuczynski has since shown that a number of European countries have reached a state of potential population decrease The dominant note is no longer fear of overpopulation but rather of population decrease and the impression left on the mind of the reader by some of the more fervid authors is that unless something is done about it mankind will become extinct not later than next Tuesday

Dr Charles begins her book with an account of the improvements in agricultural science which have increased the means of subsistence The second chapter, which gives a simple explanation of the methods of demographic statistics, leaves rather the impression that the newer methods are due almost entirely to Kuczynski As a matter of fact the net reproduction rate was first used by Boeckh, while the development of the mathematical analysis of the dynamics of population is mainly due to Lotka The decline in the birth rate and the differential fertility of social classes are next discussed and it is pointed out that if, as there is some reason to believe, the birth rates of the poorer classes, who form the larger part of the population, are approaching those of the wealthier classes, the birth rate of the whole population will decline still further

The fifth chapter is devoted to a discussion of whether the observed decline in the birth rate is the result of increase in density of population, as Pearl has concluded, or of some special cause such as the spread of contraception It is scarcely correct to say that 'Pearl himself was unable to offer any explanation of the fall in fertility observed in Drosophila" The latter[1] has found evidence "that crowding produces the observed effect on rate of egg laying primarily, though probably not solely, as a result of a collision or interference action of the flies upon each other, which alters the normal physiological equilibrium and processes of the individual, particularly with reference to three major functions—food intake, energy output in muscular activity and oviposition" Nor is the observed inverse relation between density and fertility confined to *Drosophila* It has also been observed in the flour beetle *Tribolium* over the greater part of the density range, in fowls and in human populations

The last chapter deals with changes in social organization which may make parents willing to have more children The system of family allowances, Dr Charles points out, has had little influence on the birth rate in either France or Australia, where it has been tried on a large scale Her own hope is for a new system of education by which the child would "begin to be a useful member of the community from the age of three onwards In this way children would not be felt to be a burden either to those immediately responsible for them or to the community as a whole"

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[1] R Pearl, *Jour Exp Zool*, 63 57–84, 1932

SCIENTIFIC APPARATUS AND LABORATORY METHODS

DEMONSTRATION OF BEAT NOTE AND OTHER ACOUSTIC PHENOMENA

THE phenomenon of beats and the principle of interference of sound waves is well known to every student of acoustics. It is commonly recognized that beats may give rise to a differential tone when the difference in frequencies of two loud sources of sound is sufficiently great to make a musical tone. However, the student is seldom given an opportunity to observe such tones for himself. A simple and convincing demonstration of beat note and other phenomena is possible with an inexpensive apparatus, which may be readily constructed. It consists of two shrill variable pitch metal whistles blown simultaneously through a T tube. On account of the high frequencies emitted, only a small musical interval is required to produce a loud beat note sufficiently removed in pitch from the whistles to be readily recognized by even an untrained ear. Furthermore, the beat note may be caused to rise and fall two or three

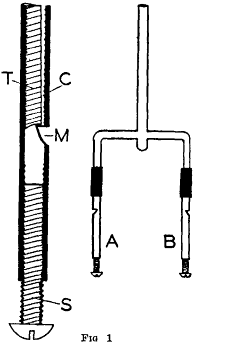

FIG. 1

octaves by altering the pitch of one whistle only two or three half tones, while the other whistle remains steady. It is easy to show that the variable low pitch sound is in reality a Helmholtz combination tone by observing its disappearance when either whistle is silenced while the other continues to emit sound.

Each whistle consists of a 6 cm length of brass tube, 4 mm internal diameter, threaded internally by a 10-32 tap. The speaking mouth *M* is a v-shaped cut filed half way through the tube at its midpoint (detail, Fig. 1). A piece of 10-32 screw, *T*, flattened on one side to make a narrow air passage, *C*, is inserted in the upper end of the tube to direct the air against the lip of the pipe. It is held in position by a bit of solder. A movable 10-32 screw *S*, controls the resonant length of the pipe and hence the pitch. The end of this screw is filed flat to make a smooth stop for the closed pipe. A drop of machine oil on the threads helps to lubricate the screw and make it airtight. Such a whistle gives a loud fundamental with an approximate range from 2,500 to 5,000 vibrations per second corresponding to an octave which includes the highest notes on the piano. It emits a tone rather free from harmonics unless strongly "overblown."

Three or four interesting phenomena may be effectively shown with this simple apparatus. (1) *Beat Note.* While maintaining whistle A at constant pitch, change whistle B from a pitch above to a pitch below A. Observe the beat note, which sounds much like the whistling of the wind on a gusty day; at first this note falls in pitch, then disappears and finally returns to rise in pitch as B continues to fall below the pitch of A. It is especially striking to observe the change of B and the beat note in opposition to each other. The whistle of the beat note sounds very much like the heterodyne whistle obtained in tuning a regenerative radio receiver. (2) *Temperature Effect.* Tune the whistles to unison by eliminating the beat note. Then, while both are sounding, hold a lighted match under one whistle. The differential tone again asserts itself, due to the increased velocity of sound and the consequent rise of pitch in the heated whistle. The flame of a Bunsen burner accentuates the effect. Both whistles should be blown through the T tube to avoid spurious pitch variations due to change of blowing pressure. (3) *Gas Density Effect.* After tuning the whistles to unison, blow one whistle with air, the other with illuminating gas passing through a long rubber tube. At the moment the gas expels the air from the tube, the pitch rises markedly in the gas blown whistle. Disconnect the tube from the gas outlet and again blow the whistle by air, noting the sudden fall in pitch which occurs when air again fills the whistle. The influence of gas density on the velocity of sound is thus convincingly demonstrated, it may be rendered still more pronounced by using compressed hydrogen or carbon dioxide, the first to cause a rise in pitch, the second to cause a lowering. Incidentally these whistles may be operated on the gas supply to produce steady high pitched sources; simply ignite the gas to prevent its escape into the room. (4) *Doppler Effect.* Attach one whistle to a piece of rubber tubing 1.5 meters long. Swing the whistle in a horizontal circle while

blowing steadily through the tube An observer seated outside the circle will hear the periodic rise and fall of pitch accompanying the approach and recession of the whistle For this experiment a medium pitch is preferable to a high since the *ratio* of pitches for approach and recession, $n_1/n_2 = V + v/V - v$, is independent of the "rest pitch" of the whistle, whereas the ear is more sensitive to variation of pitch at 2 500 vib/sec than at 5,000

Using whistles of smaller diameter than those described here, the author has pursued the beat note phenomenon to the upper limit of audibility, where the beat note disappears as soon as either whistle exceeds the audible range of the ear—in this case above 22,000 vib./sec

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AUTOMATIC HYPODERMIC INJECTOR

SELF ADMINISTRATION of medicine by the hypodermic method has become very common in recent years Ever since Dr Banting of Toronto, in 1922, isolated the hormone insulin from the islands of Langerhans in the pancreas, the injection of this substance before each meal has become the recognized treatment of diabetes The hormones of other internal secretory glands are being isolated, and promise to become control medication in various deficiency diseases Being of organic chemical composition, hormones are digested when taken by mouth and must be injected subcutaneously to give their systemic effect Patients who suffer from a hormone deficiency must have the substitute injections so frequently, usually several times a day, that it becomes impractical to have them administered by a doctor or a nurse, and necessitates the patients giving themselves the injections Besides hormones, other substances that must be injected frequently over a prolonged period of time, such as hay fever vaccine, for example, are best administered by the patients themselves

Hypodermic self injection, however, has the drawback that ordinarily it is painful And to inflict pain upon oneself is against the deep rooted instinct of self preservation The fear of pain causes a hesitancy on the part of the patient when he is about to push in the needle Hence the procedure becomes slower and more awkward than it need be Slower penetration results in more distortion of the skin, more stretching and tearing of the sensitive nerve endings, and consequently more pain

Due to this drawback many diabetic patients are denying themselves the health preserving and life-saving benefits that insulin would give them Diabetes is markedly on the increase, involving over a half million people in this country alone, and has climbed into tenth place in the list of death causes In order to encourage diabetics to use insulin, an automatic injector has been perfected, which eliminates pain by the extreme rapidity with which the needle is plunged into the tissues, and which substitutes an automatic thrust for the fearful manual push

The automatic injector consists of a compression spring within a metal casing which fits around the upper end of an ordinary insulin syringe The calibrated lower end of the syringe is left uncovered so that the dose of medication may be properly measured The spring is released by means of a trigger An adjustable foot rest at the bottom assures the correct depth and angle of needle insertion, and makes it practically impossible to break off the needle in the tissues The syringe as well as the needle are separately removable for sterilization purposes The injector is easily operated by laymen, is very durable, and last but not least is reasonable in price

It is hoped that this little device will save many a timid person from an early grave, and will dislodge diabetes from the upper part of the list of death causes

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SPECIAL ARTICLES

THE ERGOT ALKALOIDS

A RECENT preliminary report[1] has been made of the isolation of proline (as the double gold salt of its methyl ester) after hydrolysis of ergotinine in methyl alcoholic hydrochloric acid solution and also from among the products of the reductive cleavage of this alkaloid with sodium in butyl alcohol Among the products of the latter we have also obtained several other bases, one of which was interpreted as a substituted piperazine, $C_{14}H_{20}N_2$, resulting possibly from the reduction of the mixed anhydride of proline and phenylalanine and another base, a phenylpropanolamine, possibly a phenylalanine product These interpretations have been more recently substantiated by the isolation of phenylalanine itself from the products of the alkaline hydrolysis of ergotinine Thus ergotinine and therefore ergotoxine are built up of the four constituents, lysergic acid (as its amide, ergine) isobutyryl formic acid, proline and phenylalanine The accepted formula for ergotinine, $C_{35}H_{39}O_5N_5$, is consistent with the conjugation of these components (in peptide linkage) with the loss of three moles of water

We have more recently made a preliminary study of ergotamine (obtained from the ergotamine tartrate of the Sandoz Chemical Works) by the same methods.

[1] W A Jacobs and L C Craig, *Jour Am Chem Soc*, 57 383 1935 *Jour Biol Chem* 108 595, 1935

Although hampered by a very limited amount of material, suggestive results have been secured. In addition to lysergic acid and ammonia,[2] phenylalanine has been obtained from it. Less success, however, was experienced in our attempts to obtain proline as the gold salt of its ester from the alkaline hydrolysis of ergotamine or after its reductive cleavage with sodium in butyl alcohol. However, in the latter case we have isolated in addition to α and β dihydrolysergol the picrate of the piperazine, $C_{14}H_{20}N_2$, corresponding with that obtained from ergotinine. There can be little doubt, therefore, that proline is also a constituent of ergotamine. This conclusion was supported by the strong pyrrol test given by the mixed amino-acid fraction obtained from the alkaloid after alkaline hydrolysis.

In another respect, however, we have noted a striking difference between ergotinine and ergotamine. By no method have we succeeded in detecting either isobutyryl formic acid as such, or its reduction product α hydroxyisovaleric acid, as products of the cleavage of ergotamine.

Since the accepted formula for ergotamine is $C_{33}H_{35}O_5N_5$ which differs therefore from that of ergotinine by C_2H_4, the possibility was considered by us that in ergotamine and therefore also ergotaminine pyruvic acid occurs in place of the isobutyryl formic acid of ergotinine and ergotoxine. Our experience has given support to this suggestion. If ergotamine is heated a short while with dilute alcoholic alkali, the resulting solution gives a red color with nitroprusside similar to that given by pyruvic acid and which changes after addition of ammonium chloride through purple to blue. This reaction is not given by ergotinine under the same conditions. In addition, it has been possible to obtain in very small yield a phenylhydrazone from the acid fraction of the cleavage products of ergotamine, which gave the same melting point (189–190°) as the phenylhydrazone of pyruvic acid. A mixture of the two showed no depression.

On pyrolysis of ergotamine and under conditions which with ergotinine gave isobutyryl formamide without difficulty, none of the latter substance was obtained from ergotamine. Other crystalline substances, however were found in the sublimate which are now under investigation.

It is suggested that while ergotinine and ergotoxine are derivatives of lysergic acid, isobutyryl formic acid, proline and phenylalanine, in ergotamine and therefore ergotaminine isobutyryl formic acid is replaced by pyruvic acid.

Lysergic acid has probably a biogenetic relationship to tryptophane and isobutyryl formic and pyruvic acids to valine (hydroxyvaline?) and alanine (serine?), respectively.

We are attempting to confirm these findings by further investigations.

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[2] This is in agreement with the isolation of ergine from this alkaloid by Smith and Timmis (*Jour. Chem. Soc.*, 1932: 1543).

ASCORBIC ACID (VITAMIN C) AND PHOTOGRAPHIC DEVELOPING ACTION

UNTIL recently, knowledge of the chemistry of vitamin C was limited to assumptions drawn from the behavior of antiscorbutic concentrates. The experiments of the early investigators were reviewed by McCollum and Simmonds[1] in 1929 and by Sherman and Smith[2] in 1931. The evidence indicated that vitamin C was a reducing substance which was highly susceptible to oxidation in alkaline solution but comparatively stable in acid and which gave some of the reactions of polyphenols.

These properties so strongly reminded me of the photographic developing agents that, in 1931, I prepared an antiscorbutic concentrate from decitrated lemon juice, made it alkaline and tested it for developing action. It produced faint blackening on light struck photographic emulsion. Thus encouraged I reversed the procedure, testing numerous developing agents for antiscorbutic action. Needless to say this attempted short cut to the identification of vitamin C was unsuccessful, still the developing action of the lemon juice concentrate remained to be explained. Following the recent isolation and synthesis of vitamin C (*l* ascorbic acid),[3] I have employed the commercial product in a resumption of the photographic experiments.

Ascorbic acid, dissolved in water with sodium sulphite (preservative) and sodium carbonate (accelerator) in the usual proportions of a developing solution, is a rapid developer which produces a black image and considerable fog. It is unusually sensitive to bromide (restrainer). As little as 20 mgm of potassium bromide per liter of solution markedly restrains fog, considerably slows development, requires longer exposure and changes the color of the image from black to brown. The developing action is illustrated by experiments with Formula 1, prepared by dissolving the chemicals in the order indicated. This solution, in a stoppered bottle, remains usable for about a week.

[1] E. V. McCollum and N. Simmonds, "The Newer Knowledge of Nutrition," 4th ed., New York, Macmillan, 1929.

[2] H. C. Sherman and S. L. Smith, "The Vitamins," 2nd ed., New York, Chemical Catalog Company, 1931.

[3] L. J. Harris, *Ann. Rev. Biochem.*, 3: 264, 1934.

FORMULA 1 (FOR REDDISH BROWN TONES)

Distilled water	1000.0 cc
Sodium sulphite, anhydrous	12.5 gm
Sodium carbonate, anhydrous	12.5 "
Potassium bromide	0.1 "
l Ascorbic acid	5.0 "

Prints of a landscape were made on representative "chloro-bromide" papers (Noko, Azo and Velox) and on one bromide paper (Eastman P.M.C.). The relative sensitivities of these emulsions, based on development in ordinary developers, were no guide to the exposures required of prints to be developed in vitamin C. Noko No. 0, the slowest of the papers, required twice its usual exposure. It gave prints with reddish black shadows and pinkish highlights. Azo No. 2, a slightly more sensitive paper, required 10 times its normal exposure. It gave copper-colored prints of good quality. Velox No. 2, a still more sensitive paper, required about 6 times its normal exposure. It gave brown prints of mediocre quality. The highly sensitive bromide emulsion of P.M.C. No. 2 developed so slowly, in spite of relatively long exposures, that chemical fog ruined the prints before density could be built up. The optimal period of development for each emulsion was 7 minutes at 23°. Fog became noticeable in 8 minutes, serious in 15 minutes. There was no stain. The images appeared orange or light brown when wet and darkened to their final color on drying.

In Formula 2, I replaced the sodium carbonate of Formula 1 by a stronger alkali, trisodium phosphate, and increased the amount of bromide. This solution should be used within one or two days.

FORMULA 2 (FOR BROWNISH BLACK TONES)

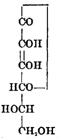
Distilled water	1000.0 cc
Sodium sulphite, anhydrous	12.5 gm
Trisodium phosphate, hydrous	40.0 "
Potassium bromide	0.5 "
l Ascorbic acid	5.0 "

Prints were made on Azo No. 2 paper. The required exposure was 3 times the normal. The optimal period of development was 3 minutes at 23°; the fog limit, 4 minutes. There was no stain. In fresh solution the images were brownish black, of good quality. Older solutions gave increasingly brown tones.

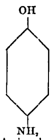
That the (photographic) reduction potential of vitamin C is low in comparison with other developers is indicated by the sensitiveness of ascorbic acid to the restraining action of bromide.[4] This low reducing energy and a comparatively high fogging power are doubtless related to the anomalous properties which Green[5] observed in his study of the potentials of this reversibly oxidizable substance.

The developing action of ascorbic acid is a fact of importance in the theory which relates developing function to molecular configuration. It should be recalled that not all reducing agents are developing agents. While innumerable organic compounds, including vitamin C, reduce silver nitrate, only a few have the power to reduce the latent image in silver halide emulsions. The classical studies of A. and L. Lumière[6, 7] on the *fonction développatrice* showed that this special reducing ability is confined, except for a few inorganic substances, to benzene derivatives in which there are two hydroxyl or two amino, or one hydroxyl and one amino groups, in the ortho or para positions. A partial exception is found in some naphthalene compounds, but in general the Lumière rule has held for over 40 years.

Ascorbic acid, a sugar derivative, is an outstanding exception, as is shown by its formula in comparison with that of a typical developer within the rule. In all probability, it is but one of a series of exceptions.



l Ascorbic acid



p-Aminophenol

Those who are interested in the chemistry of photography will want to investigate the developing action of the analogues, homologues and derivatives of ascorbic acid and the related reductones, especially since a considerable number of such compounds have been described in recent months.[3, 8]

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SCIENCE

VOL. 81 FRIDAY, MARCH 15, 1935 No. 2098

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

ANTHROPOLOGY AND GROWTH[1]

By Dr. T. WINGATE TODD

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IT would be interesting to review the history of any scientific discipline to its early days when it struggled for a mastery of its subject and note how, while it was still young and insecure, it was seized and held in bondage by a facetious charlatanry which impeded progress and held it up to derision. Chemistry, medicine, astronomy, geography, zoology flash as examples before the mind. Each in turn emancipated itself and the story of its emancipation gives to the thoughtful a thrill of satisfaction at the triumph of earnest effort over dismaying difficulties. It is, however, much more thrilling to watch the actual struggle of a science to free itself from handicap and secure for itself a prestige based upon unimpeachable technique, sound deduction and service to humanity. In physical anthropology that exciting phase has now been reached and to-day we have the privilege of watching the bursting of the entrammeling bonds of political and legislative domination by which it was enslaved during the nineteenth and early twentieth centuries.

It may be impossible to pick out the mind to which, of all others, a science is indebted for its emancipation, or to point to that particular contribution which contains the spark of quickening fire, and I arrogate neither infallibility nor omniscience in this respect As I write these words my eyes lift to the original photograph, now famous by countless copies distributed throughout the world, of his father taken by Major Leonard Darwin and presented to me as chairman of the Brush Foundation in generous encouragement of Dr. Brush's aim for betterment of the human stock. We do not attribute to Charles Darwin the first conception of evolution nor do we assert that the doctrine set forth by him would serve in its original form for all time, but we do acknowledge his

[1] Address of the vice-president and chairman of the Section of Anthropology, American Association for the Advancement of Science, Pittsburgh, December 28, 1934.

work as a source of inspiration and guidance to biological thought forever

If then, in gratitude and in acknowledgment of indebtedness which many in this room must share, I single out one mind and one piece of work for mention in my presentation, it must be understood that personal scientific indebtedness and a sense of prophecy for the future find expression in this act of homage

It seems to me that when Professor Boas described the changes in head form in children of immigrants he set a new furrow in the anthropological field and as it turns out, I believe, a master furrow So deeply ingrained is the doctrine of predestination which in its scientific form, is of course the law of heredity, that Boas's announcement was scornfully rejected by some who might have known the value of finding facts first But that incident is long past and the principle involved in Boas's conclusion has quickly permeated the modern attitude to physical anthropological problems The adult form of mankind is the outcome of growth enhanced, dwarfed, warped or mutilated by the adventures of life

I am not decrying heredity In this chair I follow an able and convincing exponent of its value for mankind But I do insist that new knowledge gained for anthropology through the study of growth brings hope and confidence where formerly was only the grim figure of destiny

Now the differences in head form between parents and their foreign born children on the one hand and their native born children on the other center in the face and characterize its transverse dimensions That central European people transferred to the east side of New York should find conditions of life vastly changed needs no emphasis The difference of paramount significance for the nursing mother and growing child lies in the price of perishable foods, particularly milk and fresh vegetables Changes in family dietary are inevitable, and while these changes can not affect adult bodily form they do have a profound influence upon the actively growing structures of infancy and early childhood

That this is no illusion is evident from the careful comparisons of the Bakwins who have shown that undernourished or malnourished children suffer more in the growth of their transverse than of their longitudinal dimensions And that this distinction characterizes body as well as head merely extends the field of operation of nutritional influences It does not invalidate but intensifies Boas's original contention

Years ago Jackson fed very young rats upon a diet which was satisfactory for health but not ample enough to increase the body weight These animals did not fail to grow They grew less rapidly than the normal controls and their ultimate size was less But the striking thing about them was not shortness of body but the deficiency in transverse dimensions This is not a characteristic of starvation It results from nutritional defect and is equally well seen in the growing guinea pigs fed by Dr Zuck on large amounts of thyroid gland

It is a curious and intriguing fact that the face is extraordinarily sensitive to disturbances of growth Owing to the kindness of Drs Sutherland Simpson and H S Liddell, of Cornell University, Dr Wharton and I were given the opportunity to study postnatal physical growth in the sheep following thyroidectomy at about one month after birth Compared with the growth of normal twin controls these thyroidectomized animals showed a definite interruption of growth in those parts of the face between orbit and mouth the growth of which is most rapid in the early months of the sheep's life The cretin sheep never grows to the size of its normal control, but this is due to a reduction in velocity of bodily growth whereby, when the period of growth which we shall later consider somewhat more intently, is over a relatively poor result is attained The dynamic centers of growth in the face have their maximum activity early in life and, growth being more seriously handicapped at that particular time, they suffer most

That disturbances of facial growth occur in human childhood is abundantly clear from the work of Broadbent and Hellman The detailed studies of the former are a part of the program of the Bolton Study, of which Broadbent is director, the Bolton Study being one of the Associated Foundations grouped about my laboratory and engaged in the investigation of the growing child Broadbent's observations demonstrate in malnourished infants a marked diminution of growth velocity in the dynamic centers of the face Hellman has shown that during the first five years of life growth is more active in antero posterior and transverse dimensions of the face, whereas the most vigorous vertical growth occurs after the fifth birthday It is particularly in transverse and antero-posterior facial dimensions that we must look for the defects of early malnutrition Recrudescence of growth occurs after the effect of the disturbance is eliminated or compensated, but by then adjustments have taken place and the growth pattern is permanently modified

Now in emphasizing particularly the effect of malnutrition upon facial growth one must not appear to belittle the heritable factors which plainly direct the general course of growth We call the expression of this heredity the family line But any one who has studied families, especially those which represent two or three generations and include growing children, is aware of marginal examples, for the principle of

heredity is one thing and its expression in bodily form is another We have, among the children studied by the Associated Foundations in Cleveland, many examples of what appears to be a modification in the younger children of family growth pattern as exemplified by the older ones so that it is unsafe to predict the course of growth in successive members of the family But, whereas most members tend to pursue a common course of developmental growth statistically expressed as regression towards the mean, these marginal individuals occur as examples of intensified family characters, people to whom a double portion has accrued for good or evil

I shall not dwell further upon marginal individuals but would refer to two other aspects of the heredity problem before I pass on The first is the ease with which some bodily features can be changed and the stubbornness of others in resisting interference This theme is well illustrated in hybridization and has its very distinct bearing on the choice and weighting of dimensions used in calculating the coefficient of racial likeness The American Negro is a good example whose entrenched features I have discussed on a former occasion The second is the ever present problem of mental defect Penrose's recent observations show that the intelligence quotient of the relatives of idiots is higher than that of the relatives of simpletons There is a rapidly accumulating mass of evidence which indicates that the origin of simple mindedness lies more in environmental conditions, whereas that of idiocy lies in primary structural defects of the brain Our solution of the social problems resulting from these two diverse forms of mental inadequacy must therefore be devised on equally diverse lines The existence of simple mindedness focuses our attention on the conservation of healthy developmental growth in the prenatal period and in infancy The problem of idiocy is less insistent because of the family limitation which occurrence of idiocy tends to produce

This brings us to the contemplation of the constructive social contribution in physical anthropology Since cumulative anthropological observation shows that hereditary patterns can be modified by conditions of life it ought to be possible to improve the physical status of mankind Fortunately there is to hand definite evidence of this in the Lanarkshire milk experiment The free distribution of milk to the school children of this Scottish county has proved statistically that healthy growth can easily be promoted by adequate and appropriate diet It is significant that the improved growth was most evident in the older children, especially the girls of the family, the inference being that, on a smaller family ration, most of the milk went to the younger children As far as health is concerned we have Dr Corry Mann's testimony to the greater irrepressibility of school boys on an adequate milk ration Following these investigations Sir J B Orr makes the plea for regulation of nutrition as the most important of state questions to day

Since the statistical survey of growth presents such encouraging conclusions it is incumbent on anthropologists to devise a technique in the long term quantitative study of growth for the accumulation of data of real social significance Suggestions for the planning of this study are therefore timely But as our present information is limited attention may be directed to a few examples

Long ago Sir Arthur Keith subdivided growth into functional and corporeal concomitants Any organ, he claimed, must grow to a certain size before it is functionally adequate Thereafter its growth is merely an increase in size commensurate with increasing bodily dimensions

That organ of the body which definitely reaches earliest functional maturity is the vestibule, the organ of static equilibrium Streeter's observations show that the vestibule is functionally active in the 20 mm human embryo, shortly before the appearance of those mass movements which serve to keep the embryo balanced in its water bath of amniotic fluid Beyond this stage and up to the time of birth the vestibule continues to grow, but this growth exemplifies Keith's corporeal concomitant After birth there is no further growth the vestibule is already adult in size

The observations of Feldberg and Disse demonstrate a growth of the olfactory area of the nose greatest before six months after birth In later infancy the respiratory part of the nose takes on its increased velocity, but the olfactory area, functionally active at birth, displays but a very small corporeal concomitant In early childhood it is the middle part of the nose which bears the burden of respiratory growth In later childhood the inferior part unfolds and growth of this area continues approximately to adolescence

A tooth, or the occlusal surface of it, has no corporeal concomitant but is already fully grown before the enamel organ first lays down mineral in its cusps and long before eruption converts it into a functionally active organ

Investigation of the eyeball by Beecher and Williams in my laboratory proves that adult size is reached at about four years, the practical implication of this being that defects of vision, which indicate anomaly of growth, must be corrected far earlier in childhood than is customary to day

But the eyeball is essentially part of the brain, and it is not surprising therefore that Loo's examination

of the cerebrum in childhood shows that adult configuration of cerebral pattern is attained between the ages of four and six years when the brain case is at least four fifths adult size In other words we send our children to school when all their mental faculties are potentially present awaiting education to transform them into abilities

The schedule of differential growth in the head is indeed most illuminating for our present purpose Brain case growth is characteristic of infancy and early childhood and with it go the antero posterior and transverse dimensions of the face, including the zygomata or malar arches Vertical or respiratory growth of the face attains maximum velocity in later childhood Vertical growth of the jaws between floor of nose and chin reaches its most vigorous phase at and after puberty

The sexual differences in facial growth provide the next clue in formulating our plan of study Brain case and upper or respiratory facial growth are common to both sexes and differ solely by the corporeal concomitant But lower facial growth from floor of nose to chin, is much greater in the male than in the female It is characteristic of anthropoids and man that bodily growth in the female practically ceases at puberty, whereas in the male, it continues for several years Hence the majority of women present a relatively small jaw growth compared with that of men That there are individual differences is less a matter of individual variation than a corollary of modified growth pattern at the cause of which we must glance in a few moments

The fact that there are periods of maximum growth activity for each organ or area of the body gives an opportunity to analyze the final condition found in the adult and to date growth disturbances which may have occurred in that individual's past Defective cranial size must have dated from infancy, deficient upper facial growth from childhood, inadequate jaw growth from adolescence None of course can be utilized to localize a date earlier than that of its own maximum activity

A relatively simple problem in growth is afforded by stature Standard tables, say the Baldwin Wood tables, for boys show a yearly increase in stature of about 50 millimeters from six to thirteen and a half years Between thirteen and a half and fifteen years the average gain is 100 millimeters in eighteen months This is the so called adolescent spurt of growth But a study of the statistical variabilities by Dr Lerro and Mrs Wood on the stature of boys under our long term observation shows that the so called individual variation sets in earlier and finishes later than these limiting dates There are, as Boas has pointed out, two groupings of boys with a smaller number of stragglers intermediate in position The one group passes through adolescence comparatively early and this accounts for the increased coefficient of variability at the younger level, while the other group passes through adolescence relatively late and accounts for the increased variability at the older level But a study, by Seymour, not yet published, of individual growth curves analyzed into leg and trunk lengths confirms the conclusion drawn by West, some forty years ago, that adolescent increased velocity of growth in stature is the result not so much of increase in rapidity of growth in leg as in enhanced trunk growth The relatively long legs and short trunk of some people, who are not themselves tall in stature, is due to defect of trunk growth rather than to increase in leg length One would summarize this study by saying that maximum velocity in leg length is a function of childhood, whereas maximum velocity in trunk length is characteristic of adolescence The differential in growth of leg and trunk is clearly marked in achondroplastic dwarfs in whom velocity of leg growth is reduced to approximately half the normal whereas the growth impulse of trunk suffers much less handicap

Growth in stature is accompanied by growth in pelvic breadth, but there is evidence in our series of children evidence which is incomplete as yet it is true, that this pelvic growth takes place in three definite successive stages, necks of femora, iliac blades and sacrum in that order Analysis of the actual growing pattern in intensive studies of individual children suggests that before long we may be able to carry on a far more penetrating study than is now possible

Mention of the pelvis reminds us that growth is not merely increase in dimensions A child grows in size but grows up to adulthood The development or progressive maturation is even more significant than the increase in dimensions The control of this maturation is not yet clearly defined and much critical analysis must still be carried out before the discordant claims on growth control are convincingly settled The appearance of menstruation, however, in most but not in all growing girls gives a clue to the relation between dimensional increase and progressive maturity at one level of developmental growth Whereas the measuring rod reveals rapid growth in stature before the menarche it shows very little afterward But roentgenograms of the growing ends of the bones testify to replacement of a lethargy of progress in maturation before by a period of greatly invigorated maturation afterward The speed of this process in the girl is a matter of common knowledge not yet scientifically stated in quantitative terms But we expect shortly to be able to make this quantitative assessment not only for girls but for boys as well.

When, in the light of fuller knowledge, a further analysis of constitutional types is made, it is on the lines of developmental growth that these constitutional types will find their explanation But one must be ware the fascination of using this method to explain in too facile a manner, differences of race or stock

Having now sketched the relationships of anthropology to growth and outlined the manner in which intensive long term studies of individuals may be made fruitful of results which in turn can be applied to the resolution of complex adult patterns it is worth a few minutes' attention to turn to the practical application of anthropology in studies of developmental growth

By enlarging analytic method to include orthodiagraphic tracings and roentgenograms which record developmental maturation, in addition to the present conventional direct measurement and statistical reduction and by recasting our selection of measurements to cover dynamic foci of growth rather than dimensions offered by chance, by ease of determination or by sheer obviousness, physical anthropology can be transformed from a static study of structural form into a kinetic study of structural progress The recognition of periods of maximal velocity of growth and of developmental maturation for particular organs and areas will clear many a confused problem It is evident, for example, from Bolk's investigations, that if sutural union occur precociously in the cranium it takes place before the age of seven years But we have seen that this coincides with the limiting date of maximal velocity of growth in the brain Irregularity in date of sutural union in human skulls is therefore probably a function of its undue delay and the problem is not to be consigned to the dragnet of individual and meaningless variation

In application to eugenics the study of structural progress gives a detailed insight into the characteristic features of family lines with their various expression in different members of the family and the development of marginal individuals

In physical education the investigation of developmental maturation by roentgenographic methods, added to the regular routine physical measurement of dimensional growth, completes the study essential to a wise application of compulsory athletics and solves many a problem of undue fatigue, of muscular tone, of inadequate heart or of deficiency in speed, power and grace

In scholastic education the anthropologist's wisely used record of differential maturity combined with that of differential growth throws light on vagaries of emotion, on problems of social adjustment, on failure in promotion and the host of problems that beset the teacher of the preadolescent grades four to six

Lastly in application to clinical medicine determinations of progress in physical maturation qualifying those of growth in stature and weight differentiate the outsize child, the subnormal child the superior child of advanced physical development, the physical impress of malnutrition, of respiratory allergic disorders such as hay fever and asthma, of the disharmonically progressing child who is a problem to himself as well as to those responsible for his guidance and health

The serial study of developmental growth is a function of the physical anthropologist not of the physician whose attention is sufficiently occupied with problems of health, but whose effectiveness of management is enhanced by the record of progress made by the anthropologist when this analysis is based on trustworthy determinations of growth and of physical development

To the newly arisen discipline of orthophylactics or correct child guidance the psychologist and clinician have devoted their energy When the anthropologist has enlarged his understanding to include progress in physical development as well as progress in physical growth he will have before him an opportunity for responsible constructive effort in an unexplored field which provides a career of usefulness and of immense social significance for as Dr Cyril Norwood claimed in a recent address, the first qualification of our children for citizenship is health and physical fitness, a body that can be trusted to do what the will commands

SUMMARY

(1) The adult physical pattern is the outcome of growth, along lines determined by heredity but enhanced, dwarfed, warped or mutilated in its expression by the influence of environment in the adventures of life

(2) Of all parts of the body the face appears to be specially sensitive to disturbances of growth It is particularly in transverse and antero posterior facial dimensions that we must look for the defects following malnutrition in infancy and early childhood

(3) Studies of growth in the several children comprising the family indicates that whereas most members tend to pursue a common course of developmental growth statistically expressed as regression towards the mean, marginal members occur as examples of intensified family characters

(4) Long term quantitative studies on child growth by families promises data of real social significance

(5) In such studies the record of development or progressive maturation is even more important than the record of dimensional increase

(6) The serial study of developmental growth offers a new field of endeavor to the anthropologist, with practical applications of great value in eugenics, in physical and scholastic education and in clinical medicine

OBITUARY

GOTTHELF CARL HUBER

THE passing of Christmas Day, 1934, saw also the passing of Gotthelf Carl Huber, M.D., D.Sc., professor of anatomy in the University of Michigan, director of the anatomical laboratory and dean of the Graduate School. He had been ill for several months, but characteristically carried the full burden of his duties up to within a few days of his death.

Dr. Huber was the son of a Swiss missionary and was born at Hoobly, India, on August 30, 1865. His parents soon removed to the United States and eventually settled at Batavia, N. Y., the boy receiving his early training in American schools. Electing to study medicine, he entered the University of Michigan at a time when Dean Vaughan was building up a new and progressive faculty. It was a constructive period and so appealed to Huber, ever ready to help on any movement, provided it were constructive. So, after graduation in 1887 he began his long term of nearly fifty years of service with the university as assistant in histology under Dr. W. H. Howell, there being at that time no place for either histology or embryology in the department of anatomy. Howell was then carrying on his studies of nerve regeneration and Huber assisted him in this work as well as in the routine classes, learning histological technique, of which he later became such a consummate master. In the succeeding years he found opportunity to visit Berlin (1890, 1891) and Prague (1895), gaining further experience in histological technique.

When Howell resigned in 1892 to accept the chair of physiology at Harvard the courses in histology and embryology fell entirely into Huber's hands and he was appointed assistant professor of these subjects and passed in due course through the grades leading to the full professorship, presiding, with success, over the courses in these subjects for forty-seven years, interrupted only by a year's leave of absence which was spent at the Wistar Institute of Anatomy in a thorough study of the embryology of the white rat. In 1914 he was appointed professor of anatomy and director of the anatomical laboratory, the courses in histology and embryology still belonging to his jurisdiction and thus recognized as parts of the anatomical discipline. In 1928 there was added to his other duties the responsible and influential deanship of the Graduate School and to this he gave freely of his time and experience.

Huber was an indefatigable worker, and even when overburdened with collegiate duties found time to carry out some valuable pieces of investigation. He mastered the more or less elusive methylene blue technique and used it in a study of nerve endings and muscle spindles and he wrote a useful review of our knowledge of the sympathetic system, unraveling its complexities and establishing a new *status a quo*. He then turned his attention to the development of the urinary tubule, upon which subject one is tempted to say that he has written the last word. Of briefer articles mention may be made of that on the fate of the anterior end of the notochord, of that on the blood vessels of the kidney and of that on the seminiferous tubule, all of which are contributions to our knowledge. During the Great War Huber served as contract surgeon and returned for a time to the study of nerve regeneration and in recent years he has been preparing, with his impeccable technique, series of sections for a thorough comparative study of the vertebrate brain, some results of which have already appeared and others are in press. Huber also edited a translation of the "Textbook of Histology" by Böhm and Davidoff, producing a book especially useful on account of its technical advice.

Huber was a member of many scientific societies, chief among which was the American Association of Anatomists, of which he was secretary from 1902 to 1913, passing then to the presidency (1914–1915). Closely related to this service was his interest in the *American Journal of Anatomy*, of which he was a co-editor from 1901 to 1920 and especially in the *Anatomical Record*, of which he was managing editor from 1909 to 1920. Of other societies of which he was a member mention may be made of the American Physiological Society, the American Association of Pathologists and Bacteriologists, the Society of Experimental Biology and Medicine, the Harvey Society, the American Philosophical Society of Philadelphia and of the Philadelphia Academy of Natural Sciences, these testifying sufficiently to the breadth of his interests and to a wide recognition of his worth. When the Advisory Board of the Wistar Institute of Anatomy and Biology was established Huber was chosen as a member and year after year was an attendant at its annual meetings. He was also an original member of the responsible Medical Fellowship Board of the National Research Council and had been chairman of the board since 1927. Northwestern University in 1930 granted him the degree of D.Sc. honoris causa, and his colleagues of the University of Michigan by appointing him to the Russell lectureship for the current year have testified to his service in maintaining and improving the academic standing of the university.

Not the least of Huber's contacts was his membership in the Alumni Association of his alma mater. He was closely associated with the organization of the

association in 1898 and from that date onward served continuously on its board of directors

Huber was a genial soul, he enjoyed meeting old friends and making new ones at the Christmas and Easter meetings, and to his friends his outstanding character seemed to be kind heartedness, he was ever ready with help in trouble or distress On the academic side the motive force was work, he early discovered for himself that that was the master word

J PLAYFAIR MCMURRICH

RECENT DEATHS

DR MICHAEL IDVORSKY PUPIN, emeritus professor of electromechanics at Columbia University, died on March 12 in his seventy seventh year

DR WILLIAM DUANE emeritus professor of biophysics at Harvard University, died on March 7 at the age of sixty three years

DR FRANKLIN H MARTIN, director general and founder of the American College of Surgeons in Chicago, died on March 7 He was seventy seven years of age

CHARLES DENISON HOLMES the inventor, who recently received thanks from President Roosevelt on behalf of the government for his work on marine internal combustion engines during the war, died on February 28

PROFESSOR J MACMILLAN BROWN chancellor of the University of New Zealand professor of English literature and an authority on ethnology, died on January 18 at the age of eighty nine years

SCIENTIFIC EVENTS

ETHNOGRAPHICAL FILMS

Nature reports that the trustees of the British Museum have accepted the donation of a cinematograph film of the life of the Worora tribe of the Kimberley district of northwest Australia The film was presented by H R Balfour of Melbourne It was taken on the Government Native Reserve of Kunmunya, and shows the present conditions of native life Technological processes, such as the making of stone axes and spear heads, in which these people are specially skilled, the making of fire by twirling one stick on another, the spinning of human hair for thread and the like are shown as living crafts The "shots also include ceremonies and dances and an emu corroboree The film has already been shown to missionaries, learned societies and medical students in Australia, but, as is explained by Sir George Hill in a letter to the London *Times* of February 7, owing to the fact that it was taken on a government reserve, under the regulations of the Commonwealth Government, it can not be shown commercially With the permission of the trustees of the museum, arrangements have been made for the film to be shown at a meeting of the Royal Anthropological Institute to be held on March 19 at the London School of Hygiene and Tropical Medicine A description of the film has been supplied by the Rev J R B Love, who is superintendent of the reserve and is well acquainted with the language of the Worora

It is further stated in *Nature* that the possibility of forming such a collection or repository was one of a number of points connected with the making, selection and preservation of cinematograph films of anthropological and ethnographical interest, which was referred to a special committee appointed by the recent International Congress of Anthropological Sciences held in London in August last The committee is international in its composition, Great Britain being represented by Captain T A Joyce, of the British Museum It is announced in the February issue of *Man* that the British Film Institute has established a Scientific Research Panel of its Advisory Council, of which Professor J L Myres will act as chairman, to collect information as to the extent to which the cinematograph has been used in scientific work, details of methods and difficulties in technique, and particulars of films of scientific interest which have not been put into circulation through the ordinary commercial channels The panel will welcome information on any of these points, communications should be addressed to the Secretary British Film Institute, 4 Great Russell Street, London, W 1

ANNIVERSARY OF THE BLUE HILL OBSERVATORY

A CELEBRATION of the fiftieth anniversary of the first regular observation made at the Blue Hill Meteorological Observatory, Harvard University, was held on February 1 by members and ex members of the staff and guests from the Harvard College Observatory, the U S Weather Bureau and the Massachusetts Institute of Technology

After an inspection of the building, the group met in the radio room on the top floor of the tower, where they heard the hourly automatic tone signal, the strength of which is noted at Mt Washington and Seabrook Beach, N H, and at West Hartford, Connecticut A E Bent, in charge of the radio station at Blue Hill, then established contact with A A McKenzie, in charge of the station on Mt Washington, and through him talked with Joseph B Dodge, founder and manager of the Mt Washington Observatory and observer at the Pinkham Notch station Next, also through Mt Washington, contact was

made with Henry S Shaw, a member of the over seers' committee for Blue Hill, at his home in Exeter, N H Dr Willard P Gerrish, assistant professor of mechanical engineering at the Harvard Astronomical Observatory, replied to Mr Shaw's greetings Mr Bent summarized briefly the nature of the Blue Hill radio equipment—including both 5 meter and 2½ meter sending and receiving sets—used in experimenting with transmission over distances which approach the limits possible with such equipment

Dr Gerrish, first observer at the Blue Hill Station, H Helm Clayton and S P Fergusson, members of the staff during the early days of the observatory, described its opening Letters were read from Dr Alexander McAdie, director emeritus, who is now in Virginia, L A Wells, a former member of the staff, Dr Oliver L Fassig research associate, who is now conducting studies in Puerto Rico, Dr H H Kimball, research associate, Dr S S Drury and John Woodbury, members of the Harvard Overseers Committee on Blue Hill

Dr Harlow Shapley, director and Paine professor of practical astronomy at the Harvard Observatory, gave a summary of meteorology in relation to the astronomical observatory, and G H Noyes spoke as a representative of the U S Weather Bureau In conclusion, Dr Charles F Brooks, director at Blue Hill, outlined some phases of the work now being done at the observatory and the possibilities for future studies

THE YALE NORTH INDIA EXPEDITION

PLANS for the second North India Expedition, which will investigate the background of primitive man under the leadership of Dr Hellmut de Terra, of Yale University, have been made public The expedition will carry on its investigations under the auspices of Yale University, the Carnegie Institution of Washington, the American Philosophical Society, the Geological Survey of India and the Cenozoic Research Laboratory in Peking, China

Dr de Terra, who was the leader of the first expedition and goes into the Himalayas now for the third time, was geologist of the German Central Asia Expedition in 1927–28, the following year serving as curator in the Museum of Natural History in Berlin He went to Yale University in 1930 and is research associate in Peabody Museum

Dr de Terra, accompanied by Mrs de Terra, who will take part in the field work, sailed from New York on February 2 They will be joined in India by Père Teilhard de Chardin, acting director of the Cenozoic Research Laboratory, who is paleontologist of the present expedition, and by V N Ayengar, paleontological collector of the Survey of India It is expected that several British institutions will be jointly represented by T T Patterson, of the University of Cambridge, who will cooperate in the fields of geology and archeology M de Chardin has carried on research in China, having assisted in the paleontological investigation that led to the discovery of the Peking man Dr Ayengar has spent several seasons in the Himalayas collecting fossils buried in ancient geologic formations

The expedition, which will confine its field to the Southern Himalayas, will begin its work in the Salt Range, which is one of the smaller mountain ranges of northern India, and lies some eighty miles south of the Himalayas It will reach Kashmir at the beginning of the summer and by autumn will commence research in Himalayan foot hills The circuit to the Salt Range will be completed the following winter The background of early mankind will be investigated from the paleontological, geological and archeological standpoints

The first expedition, which spent more than a year in this region, brought back information of the youthful character of the mountains George E Lewis, of Yale University paleontologist of the first expedition, collected a large number of fossils, including ten fragmentary remains of man like apes, of which one is said to be regarded as the most human like fossil ape so far recorded In addition to this new information on the evolution of man, Dr de Terra found several sites of artifacts dating back to the Old Stone Age, which indicate that early man inhabited the Himalayan foothills The biologist of the first expedition, Professor G Evelyn Hutchinson, also of Yale University, collected data on the distribution and adaptation of fresh water life to high altitudes The remains of hitherto unknown specimens of man like apes which were discovered consisted of five fossil jaws, each retaining two or more teeth, as well as several individual teeth Later study revealed the presence of a new species belonging to a known genus, and three new genera, two of which probably represent, more than any other genus yet uncovered, a much closer approximation to the main trunk

THE COMING MINNEAPOLIS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PREPARATIONS for the summer meeting at Minneapolis are progressing well Arrangements have been concluded for joint sessions between the Minnesota State Medical Society, which is meeting at the same time in Minneapolis on Monday and Tuesday, and the association which extends its program to include the week from June 24 to June 29 A goodly number of affiliated societies are meeting with the association at various times during the week Headquarters for the association have been set for the Hotel Nicollet. This is in the business section easily accessible

to the various railroad stations Hotel facilities are abundant and reasonable in price The meetings will be held on the new campus of the University of Minnesota The splendid lecture hall of the Northrup Auditorium will be used for the evening general sessions

Several prominent scientists have been secured for the addresses at these sessions, but the exact dates are not yet adjusted The various biological sections and affiliated societies are planning extensive programs with emphasis upon the relations of biological sciences to medicine as naturally associated with the meeting of the Minneapolis State Medical Society at the same time Similar emphasis is being laid upon the important relations of various fields in pure and applied science to prominent questions of land planning, soil erosion, stream control and utilization, and other features intimately related to Minnesota and the adjacent regions

In accordance with the general plan which has operated successfully in recent summer meetings, programs are being primarily devoted to symposia, discussions of significant regional problems and joint sessions between sections The afternoon is left open for field work, round tables, informal conferences and social gatherings Some unusual opportunities will be given for seeing striking features of the region and for longer trips at the close of the sessions Members of various sections desirous of presenting papers or participating in discussions will communicate with section secretaries, who will see that requests are properly forwarded In accordance with previous custom it is not expected that section secretaries should attend and be responsible for programs of two meetings within the year Unexpected complications prevent the publication at this time of the list of acting secretaries who will serve the various sections for the Minneapolis meeting Communications may also be sent through the office of the permanent secretary, Smithsonian Institution Building, Washington, D C

Railroad rates, while not yet officially announced, will be favorable as usual Those residing at a distance will probably find summer excursion rates most advantageous Further announcements on this and other points will appear in later issues of SCIENCE The preliminary program will be printed as usual the last of May

HENRY B WARD,
Permanent Secretary

IN COMMEMORATION OF DR G CARL HUBER AND DR DAVID WHITE

IN commemoration of the association with the National Research Council of Dr G Carl Huber, of the University of Michigan, and of Dr David White, of the U S Geological Survey, extending over many years, the administrative committee of the council adopted the following resolutions at its meeting in Washington, D C, on February 16

WHEREAS, the National Research Council has learned with deep regret of the death of Doctor G Carl Huber, professor of anatomy, director of the Anatomical Laboratories, and dean of the Graduate School of the University of Michigan, and a member of the faculty of the University since 1887, and

WHEREAS, the National Research Council recalls with full appreciation the high value of the services which Dr Huber has generously given to the administration of the fellowships of the Medical Fellowship Board of the council, and

WHEREAS, the National Research Council recognizes the many contributions which Dr Huber has made to medicine and to medical education in the United States, it is

Resolved that the National Research Council records its high esteem for Dr Huber and extends its sympathy to the members of his family, and directs that a copy of this resolution be sent to Dr Huber's family

WHEREAS, the National Research Council has learned with deep regret of the death of Dr David White, special scientist in the United States Geological Survey and a member of the survey since 1886, and

WHEREAS, Dr White has been constantly associated with the National Research Council since 1919 as a member of the Executive Board of the Council and through the council's Division of Geology and Geography in which he served as a member for many years and as chairman of the Division from 1924 to 1927 and as a member of committees of the Division, and

WHEREAS, the National Research Council is greatly indebted to Dr White for sound advice and unfailing support during these years, it is

Resolved, that the National Research Council places on record its recognition of the especially meritorious services which Dr White has rendered in carrying out the purposes for which the council was established, in advancing the science of geology, and in stimulating research in other fields of science as well, and that the council extends its sympathy and directs that a copy of this resolution be transmitted to Dr White's family

SCIENTIFIC NOTES AND NEWS

THE council of the Royal Society, London, has recommended for election into the society seventeen candidates, as follows N K Adam, research chemist, University College, London, E N da C Andrade, Quain professor of physics, University of London, Sir Frederick G Banting, professor of medical research, University of Toronto, S P Bedson, professor of bacteriology, London Hospital, E J Bowen,

fellow of University College, University of Oxford, G E Briggs lecturer in plant physiology, University of Cambridge, H G Cannon professor of zoology, University of Manchester W E le Gros Clark, professor of anatomy, University of Oxford, J S Foster, professor of physics, McGill University, A L Hall, lately assistant director of the Geological Survey of the Union of South Africa, W H Hatfield, Brown Firth Research Laboratory, Sheffield J de Graaff Hunter, lately of the Survey of India B A Keen, Rothamsted Experimental Station, R A Peters, Whitley professor of biochemistry, University of Oxford, J Read, professor of chemistry University of St Andrews, R N Salaman director of the Potato Virus Research Station Cambridge, and R Stoneley, lecturer in mathematics University of Cambridge

WE learn from *Nature* that the following have recently been elected foreign members of the Royal Academy of Sciences, Stockholm Dr Robert Robinson professor of chemistry in the University of Oxford Dr Frank D Adams, emeritus Logan professor of geology in McGill University, Dr Ejnar Hertzsprung, professor of astrophysics in the University of Leyden Holland, and Dr A V Hill Foulerton research professor of the Royal Society formerly Jodrell professor of physiology in University College, London

THE George W Carpenter Prize of the Academy of Natural Sciences of Philadelphia, awarded each year for the best piece of original scientific research, was presented at the annual meeting to Dr Henry A Pilsbry curator of mollusca In addition to a cash prize, the award carries with it the publication of the research work of the recipient, which in this case will consist of a study of land mollusca of North America

BRONZE medals and citations were conferred by Rutgers University on March 1 on Dr Walter T Marvin dean of the College of Arts and Sciences, "for able and devoted service and on Dr Thomas J Headlee, professor of entomology and entomologist at the New Jersey Agricultural Experiment Station, "as a valued servant of the university and the state"

THE award of the Charles A Coffin Foundation, the highest honor which the General Electric Company can bestow upon an employee, was made on March 1 to August Kayser, a tool designer at the company's plant at Fort Wayne, who has been with the company forty four years The award was given to Mr Kayser for ingenuity in designing, building and making improvements in special automatic machines

HARVARD UNIVERSITY has announced the following changes The resignation of Dr Alice Hamilton, assistant professor of industrial medicine at the Harvard Medical School since 1919, to take effect on September 1 the promotion of Dr Joseph Leonard Walsh to a professorship of mathematics, and the election of Hassler Whitney to an assistant professorship of mathematics and of John Gilbert Beebe Center to a lectureship in psychology

DR LILLIAN MOLLER GILBRETH, consulting engineer has been appointed professor of management at Purdue University the appointment to become effective next September

DR ARTUR HAAS, professor of physics at the University of Vienna, has been invited to serve as visiting professor of physics next year at the Drexel Institute of Philadelphia He delivered a lecture at the institute on February 26

THE Natural History Museum of San Diego, California, has announced the addition to its staff on February 1 of Adriaan J van Rossem, formerly research fellow in the department of vertebrate zoology at the California Institute of Technology

F A SILCOX, chief forester, has announced the following reassignments in the research organization of the Forest Service of the U S Department of Agriculture C L Forsling, director of the Intermountain Forest and Range Experiment Station at Ogden, Utah will become director of the Appalachian Forest Experiment Station with headquarters at Asheville, N C E H Frothingham who has served as director of the Appalachian Station since its organization in 1920, has, at his own request, been relieved of the directorship so that he may concentrate his efforts on silvicultural research Dr Reed W Bailey associate professor of geology at Utah State Agricultural College, who for the past year has been serving as conservationist at the Intermountain Station while on leave from the college, will become director of the station, with headquarters at Ogden

L J GRAHAM and F E James, of the department of agricultural and biological chemistry Pennsylvania State College, have accepted research positions with the G W Carnrick Company, of Newark, N J, and the Ralston Purina Company, of St Louis, Mo, respectively

GEORGE H FANCHER has resigned as assistant professor of petroleum and natural gas engineering at the Pennsylvania State College to accept a position with the York State Oil Company, of Caney, Kansas

DR PAUL C KITCHEN, assistant professor of histological and clinical dentistry at the Ohio State University, has been named assistant editor of *The Journal of Dental Research*, published by the International Association for Dental Research He is also

secretary of the program committee on research of the American Dental Association

DR HAROLD C UREY, professor of chemistry at Columbia University, Nobel prize laureate for 1934 returned on March 9 from England and Scandinavia

DR CARL L HUBBS, curator of fishes at the museum of zoology and director of the Institute for Fisheries Research of the University of Michigan, and Dr Henry van der Schalie, assistant curator of the division of mollusks, started during the last week of January on the fourth university expedition into Central America under the auspices of the Carnegie Institution at Washington They will search for rare species of fish and mollusks in the region near Lake Petin, Guatemala

DR ROBERT K ENDERS assistant professor of zoology at Swarthmore College, has returned from Panama, where he conducted research on animal behavior and collected several rare specimens of monkeys and sloths He expects to return to the Barro Colorado Island laboratory of the Institute for Research in Tropical America in the near future for further research

HENRY FIELD a member of the staff of the Field Museum of Natural History, Chicago, has invited the Soviet Academy of Science to cooperate in an expedition for anthropological research among the peoples of the Caucasus

DR CHARLES A SHULL, professor of plant physiology at the University of Chicago, will lecture before the Graduate College at the University of Iowa on March 25, on "Radiation and Life ' He will also give an address before the botany seminar on 'Plant Carotinoids."

ON February 28 and March 1, Dr William Crocker managing director of the Boyce Thompson Institute for Plant Research, lectured before the division of biology of the Canadian National Research Council at Ottawa, Canada, on "The Effect of Light and Unsaturated Carbon Containing Gases on Plants' and on "Delayed or Distributed Germination of Seeds"

DR ALEXANDER SILVERMAN, head of the department of chemistry in the University of Pittsburgh, addressed the members of the Franklin Institute in Philadelphia on February 7 on "Glass An Indispensable Factor in Modern Civilization"

DR. ALFRED C LANE, professor of geology at Tufts College and chairman of the committee on the determination of geologic time of the National Research Council, delivered a lecture at Bryn Mawr College on February 22 on "The Age of the Earth" On February 23 he spoke before the department of geology on "Correlation of the Pre-Cambrian Rocks"

DR ERNEST CARROLL FAUST, professor of parasitology, Tulane University School of Medicine, addressed the Sigma Xi Club of the University of Georgia on January 18 His subject was Some Biological Aspects of Public Health Problems in the South '

DR JOHN R MURLIN professor of physiology and director of the department of vital economics in the University of Rochester Medical School, gave the annual address before the Michigan State College chapter of the Sigma Xi on February 6 His subject was Recent Developments in the Study of Energy Metabolism of the Human Body" He also spoke at a faculty club luncheon on 'A Physiological Conspiracy '

DR EDGAR T WHERRY associate professor of botany at the University of Pennsylvania and ecologist of the Morris Arboretum, lectured before the Muhlenburg Botanical Club at Lancaster, Pennsylvania, on March 6

DR OLAF ANDERSEN of the U S Steel Research Laboratory, Kearney N J formerly of the Geophysical Laboratory of the Carnegie Institution of Washington completed in January before the department of geology, Princeton University, a series of nine lecturers on Phase Equilibrium Diagrams of the Refractory Oxides, Their Interpretation and Application to Slags Refractories and Igneous Rocks '

CHARLES A EDWARDS principal of the University College of Swansea, Wales addressed the Washington Academy of Sciences on March 8 His subject was Science, Education and Industry Whither Drifting?'

A SERIES of six public lectures on aerophotography is being given at the institute of geographical exploration, Harvard University The first in the series, on February 6, by Captain Albert W Stevens, was entitled The National Geographic Army Air Corps Stratosphere Flight of 1934 ' The other lecturers are Captain B C Hill, on February 20, Lieutenant J F Phillips, on April 24, and Captain D M Reeves, on May 1

THE Society of Sigma Xi of the University of California has announced the following illustrated lectures to be delivered under the auspices of the chapter February 20, Dr W H Kellogg, chief of the bureau of laboratories, State Department of Public Health, "The Black Death in Modern Times", March 6, Professor Joel Stebbins, director of the Washburn Observatory, University of Wisconsin, "The Dark Galaxy", March 27, Dr C E ZoBell, of the Scripps Institution of Oceanography, "The Occurrence and Significance of Bacteria in the Sea", April 10, Dr H S Smith entomologist of the Citrus

Experiment Station, Riverside, "Adaptations to the Parasitic Life in Insects", May 1, Dr Ralph W Chaney, professor of paleontology, University of California, "Forest Migrations Around the Pacific", May 22, Dr P H M P Brinton, research chemist and visiting professor of chemistry at the University of Southern California, "The Work of the Chemist in the Detection of Crime"

THE American Institute has announced the following lectures March 12, "Biological Effects of Radiation of Various Wave Lengths," by Dr Ellice McDonald, director of cancer research at the University of Pennsylvania, with Dr Hugh S Taylor, director of the Frick Chemical Laboratory of Princeton University, as guest authority, March 19, "Modern Fermentation Processes and Products," by Dr Charles N Frey, director of the Fleischmann Laboratories, with Dr John A W Hartung chief chemist of the Jacob Ruppert Brewing Company, as guest authority, March 25, "Recent Advances in the Treatment and Management of Chronic Arthritis," by Dr William Bryant Rawls, lecturer in medicine at the New York Polyclinic Medical School, with Dr Russell L Cecil, clinical professor of medicine at Cornell University, as guest authority

THE annual meeting of the Alabama Academy of Science will be held on April 12 and 13 at the State Teachers College at Florence, Ala, which is situated in the Muscle Shoals district Titles for papers to be read at the meeting should be sent to the secretary, P H Yancey, Spring Hill College, Mobile, Ala, not later than March 20

THE eleventh scientific session of the American Heart Association will be held on Tuesday, June 11, from 9 30 to 5 30 P M at the Hotel Claridge, Atlantic City, N J The program will be devoted to various subjects on cardiovascular disease

THE committee on scientific research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine Preference is given to requests for moderate amounts to meet specific needs Application forms can be obtained from the committee at 535 North Dearborn Street, Chicago, Illinois

THE New Hampshire Forestry Department announces that applications for research fellowships in forestry and allied subjects should be made to the Caroline A Fox Research and Demonstration Forest, Hillsboro, N H, not later than April 15 The fellowships are open to men and women who have completed three years' work, not necessarily in forestry, in a college of recognized standing Projects may be undertaken in fields allied to forestry, such as botany, zoology, soil science, climatology, economics and sociology Appointments, which ordinarily carry a stipend of $150, are for one year from June 1 Appointees must be in residence at Hillsboro and in the field in New Hampshire for a minimum of two months

FORMAL approval has been given by the board of supervisors of Louisiana State University to the establishment of schools of dentistry and pharmacy in the division of medical instruction The division is to be known as The Louisiana State University Medical Center Pending erection of a new building on the Charity Hospital grounds in New Orleans, the two schools will be housed in the main building of the center Applications for enrolment are now being accepted

DISCUSSION

BACKGROUND AND ORIGIN OF THE AMERICAN ASSOCIATION

THOSE who are interested in the history of American science and in the organization of scientific men will find in the most recent volume of "Summarized Proceedings" of the American Association for the Advancement of Science (for 1929–1934) a short but unusually interesting and valuable historical chapter contributed by Austin H Clark and Leila Forbes Clark A short review of that chapter for the readers of SCIENCE seems worth while Beginning with a sketch of the status of science in the American colonies of England and in the mother country, about the middle of the seventeenth century, the authors point out that freedom of thought and action was at that time greater in the colonies and that there consequently arose an embryo plan, according to which some of the leaders of British science (Boyle and others) were to join John Winthrop the younger in New England, there to establish a "Society for the Promotion of Natural Knowledge" The proposed emigration did not occur, however, and the Royal Society, chartered by King Charles II in 1662, published in its *Transactions* most of the records of American research for over a century

Under the leadership of Benjamin Franklin an "American Philosophical Society" was started about 1743, but its life was short Another organization, "The American Society for Promoting and Propagating Useful Knowledge held in Philadelphia," was formed in 1766, with Benjamin Franklin president, and two years later its title was changed to "The American Society held at Philadelphia for Promoting Useful Knowledge." A new "American Philosophical

Society" had been formed in the meantime and these two became merged in 1769, after prolonged negotiations, with a new name that has since become familiar, "The American Philosophical Society held at Philadelphia for Promoting Useful Knowledge."

The well known "American Academy of Arts and Sciences," established in Boston, was incorporated in 1780. The "Academy of Arts and Sciences of the United States of America" was started about 1788 in Richmond, Virginia, but did not thrive very long.

In the presidential administration (1801–1809) of Thomas Jefferson, who was prominent in the American Philosophical Society and was in touch with the intellectual life of his period, was established the United States Corps of Engineers, which was a nucleus for the "United States Military Philosophical Society." The latter, which was apparently the first truly national American scientific society, died soon after 1810. The "Columbian Institute for the Promotion of Arts and Sciences," incorporated by Congress in 1818, soon passed into the "National Institution for the Promotion of Science," organized in 1840. That institution arranged a national congress of scientific men, held in Washington in April, 1844, to which were invited all other American scientific organizations and all individuals interested in the advancement of knowledge, but no other meetings of that kind were held and the National Institution finally went out of existence in 1861.

Under the leadership of Dr. John Collins Warren, a Boston group urged the desirability of forming an American association after the pattern of the British Association for the Advancement of Science, but they referred their proposal to the American Philosophical Society and received a discouraging reply in April, 1839. Meanwhile, the "Association of American Geologists" had been organized. It held its first and second meetings at Philadelphia (1840, 1841) and its name was changed to "The Association of American Geologists and Naturalists" at its third meeting, held at Boston in 1842. The last meeting of this organization occurred in 1847, also in Boston. At that meeting, in which Dr. Warren took part, it was voted that the "Association of American Geologists and Naturalists" should resolve itself into the "American Association for the Promotion of Science" and it was arranged that the resulting enlarged association should hold its first meeting at Philadelphia the following year. At the first session of that first meeting, on September 20, 1848, the name of the organization was changed to the "American Association for the Advancement of Science," and William C. Redfield was elected and installed in the afternoon of the same day, as the first president of the association. The association was incorporated by act of the Senate and House of Representatives of the Commonwealth of Massachusetts in March, 1874.

An account of the history of the American Association, by Dr. Herman W. Fairchild, presented at the seventy-fifth anniversary meeting, at Cincinnati, in December, 1923, was published in SCIENCE, Volume 59, 1924.

Besides the chapter on background and origin, this last volume of Summarized Proceedings contains much interesting information about the recent activities of the association. A graph shows that the paid-up membership increased rather steadily from 10,002 in 1920 to 18,269 in 1931, after which it decreased to only 15,728 in 1933, but it increased to 16,429 in 1934. The volume reports annual meetings held at Des Moines, Cleveland, New Orleans, Atlantic City and Boston, and the intervening summer meetings, with the usual lists of officers and references to notes and addresses that were published in SCIENCE. It contains the complete list of sustaining and life members and the very useful Directory of Fellows and other Members, corrected to June, 1934.

For the first time, the value and usefulness of the directory are greatly enhanced by the addition of an 82-page geographical index, which shows the section enrolment of every member. By means of this index, it is easy to ascertain exactly which members reside in any locality and to classify them according to the branches of science in which they are engaged.

Copies of the book may be obtained from the office of the American Association, Smithsonian Institution Building, Washington, D. C., the postpaid prices being $3.00 (cloth binding) or $2.50 (paper cover) to those whose names occur in the directory, and $4.00 or $5.00 to others.

BURTON E. LIVINGSTON

REMARKS ON SULAIMAN'S THEORY OF RELATIVITY

IN view of the interest aroused in Sir Shah Sulaiman's new theory of relativity[1] by Professor Shapley's characterization of it in SCIENCE for November 16, 1934, as one of the "high lights of astronomy during the past year," the following considerations may be of interest.

Sulaiman bases his theory of gravitation on "gravitons," fine particles "at present beyond the range of our perceptions." It appears, from the brief statement in his first paper, that this hypothesis is essentially the same as that put forward by LeSage in 1764 as an explanation of gravitation.[2] Also, both

[1] *Proc. Acad. of Sciences, U. P., India*, Vol. 4, Part 1, pp. 1–36, 1934.

[2] Cf. *Enc. d. Math. Wiss.*, Band V-1, pp. 57–64 or, more briefly, Lorentz, *Lect. on Theor. Phys.*, vol. 1, pp. 151–155.

theories lead to a shifting forward of the direction of attraction between two relatively moving bodies, a phenomenon exactly analogous to the aberration of light

The effect of this aberration on the planetary orbits was first discussed by Laplace He found that the resulting tangential acceleration of the planets had no effect on the longitude of perihelion, but introduced secular perturbations in the semi major axis and eccentricity of the orbit and in the mean longitude of the planet in the orbit

According to Jenneck,[3] calculations based upon Laplace's theory and upon the unexplained secular variations of the semi major axis of the moon s orbit give as the lower limit of possible values for the velocity of propagation of gravitation about 10^8 times the velocity of light Chazy[4] makes the following statement

Si l'on admet comme résultat des observations que l'accroissement séculaire de la longitude ne peut depasser 2″ pour la Terre et 0 5 pour Mercure et si l'on cherche à expliquer par l hypothèse précédente [Laplace's hypothesis] une accélération de la Lune de 2 au plus par siècle, on obtient trois limites inférieures de la vitesse V_1 [velocity of propagation of gravitation] voisines respectivement de 6 millions, 600 millions et 30 millions de fois la vitesse de la lumière

Sulaiman introduces, in effect, a slight modification of Laplace's theory in changing the magnitude of the attracting force (which Laplace kept unchanged from the Newtonian law) by the factor $\left(1-\frac{v}{D}\right)^3$, v being the radial velocity and D the velocity of propagation of gravitation, assumed by Sulaiman to be nearly equal to the velocity of light The net result of this change is to introduce an advance of the perihelion close to the desired value in the case of Mercury However, nothing is accomplished toward removing the objectionably large secular perturbations of Laplace's theory, on the contrary, the perturbation of the eccentricity is doubled

To be specific with regard to this last point, calculations based upon Sulaiman's formulae (calculations which he apparently has not carried out) give for the secular logarithmic perturbations, in one earth year, of the semi major axis and eccentricity, respectively, of Mercury's orbit the values 009643 and 01275 Tisserand,[5] quoting Newcomb's "Fundamental Constants of Astronomy," gives in the case of the eccentricity the discrepancy between Newtonian theory and observation (reduced here to a period of one year) as $(-4\,3 \pm 2\,5) \times 10^{-8}$—of opposite sign from the change predicted by Sulaiman's formula In the case of the eccentricity of Venus, Earth and Mars, Newcomb and Sulaiman agree as regards sign, but to bring the values calculated from Sulaiman's formula into agreement with Newcomb's figures, it is necessary in using Sulaiman's formula to give D values ranging from 6×10^4 times the velocity of light (Mars) to 2×10^6 in the case of the earth

The absurd size of Sulaiman's perturbations may be realized from the fact that the above calculated perturbation in Mercury's eccentricity is equivalent to an absolute yearly increase of 0026 in the eccentricity As the eccentricity increases this of course does not remain constant, but taking it as a constant for the sake of illustration, Mercury's eccentricity would in 300 years reach unity and the planet would go off in a parabolic orbit!

Sulaiman s theory, in so far as it relates to gravitation, would seem then, to founder on the same rock as Laplace s mathematically analogous theory and the modified forms of LeSage's physically similar theory Neither are valid unless to the velocity of propagation of gravitation is assigned enormous values from 10^5 to 10^8 that of light, and aside from the objections to this, if this is done in Sulaiman's case the desired advance of the perihelion is reduced to a negligible value and the theory accomplishes nothing in gravitational phenomena

I take this opportunity to make acknowledgment of my indebtedness to Professor H P Robertson, of Princeton University, who suggested this investigation and gave valuable assistance in the pursuit of it

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[3] *Enc d Math Wiss*, Band V-1, p 49
[4] Chazy, "La Théorie de la Relativité," vol 2, p 134
[5] Tisserand, "Mécanique Celeste," vol 4, p 535

LAST CALL FOR CULTURE METHODS

THE committee of American zoologists, commissioned to compile and issue a compendium of culture methods for invertebrate animals, desires to express its appreciation of the cordial cooperation already received and to issue a last call for further contributions

The committee met in Pittsburgh on December 26 and went over the large number of valuable manuscripts already received, making note of others promised and of the many gaps still remaining The month of June, 1935, has been set as the latest date for the receipt of further contributions It is the hope of the committee that the volume containing these contributions may be ready for the printer in September

The committee is receiving articles on culture methods and lesser notes on the "tricks of the trade" from those who have had experience These will be as-

sembled for publication over their authors' signatures Conciseness is essential and, as stated in a former notice in these columns,[1] "the committee reserves the right to condense and combine" where necessary

Any one who has developed or improved methods of culturing invertebrate animals and wishes to assist in making this volume as complete as possible is cordially invited to communicate with the committee's secretary, Miss Mary E Davis, Comstock Hall, Ithaca, N Y, or with any member of the committee

FRANK E LUTZ
PAUL S GALTSOFF
PAUL S WELCH
JAMES G NEEDHAM, *Chairman*

CHEMICAL COMPOSITION OF LARGE AQUATIC PLANTS

THE general investigations relating to the productivity of Wisconsin lakes have included studies of the chemical composition of the larger aquatic plants Since these plants serve as a source of food, not only for strictly aquatic forms such as oligochetes, mollusks, insect larvae and fish but also for such animals as ducks and deer, their food value was regarded as an important item in these chemical studies

Four papers dealing with the organic as well as the inorganic content of some of the larger aquatics were published by Schuette[1] between 1921 and 1929, which indicated the general food value of the forms that were analyzed It is interesting to note that the chemical results published by Gortner[2] in a recent number of SCIENCE for the large aquatics of Minnesota lakes are in reasonably close agreement with those obtained by Schuette The greatest difference is found in the Potamogetons, where the Wisconsin material yielded a somewhat smaller percentage of crude protein and a larger percentage of nitrogen free extract than that from the Minnesota lakes Birge and Juday[3] found that the percentage of crude protein varied with the stage of maturity of these plants, while Harper and Daniel[4] noted that the percentage of nitrogen varied with the character of the soil on which they grew, thus these two factors are probably responsible for the more marked differences noted in the Potamogetons

With respect to the annual yield of large aquatic plants, Rickett[5] estimated the crop in Lake Mendota at 2,000 kilograms per hectare (1,800 pounds per acre), dry weight, in the zone occupied by them and 1,780 kilograms per hectare (1 580 pounds per acre) in Green Lake Similar studies have been made on a dozen lakes in northern Wisconsin, while a report on this work has not been completed, the data indicate that the crop of large aquatics in them is much smaller, especially in those with soft water

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CONCERNING THE TASTE OF HEAVY WATER

IN discussing the recent press reports of the drinking of heavy water by Professor Hansen, of Oslo, the present writers could not account for the "dry burning sensation" said to have been experienced by Professor Hansen—assuming that it had been due to the water Accordingly, it was decided to make a personal test

In order to make the experiment as objective as possible, a third person in a different room prepared the samples to be tasted Each of us was then given two identical watch glasses, one containing one cubic centimeter of ordinary distilled water, and the other the same amount of pure heavy water, especially prepared for biological experiments One of us kept each sample in his mouth for a short time to make sure of its taste, and then spat it out The other repeated the same procedure, but swallowed the water Neither of us could detect the slightest difference between the taste of ordinary distilled water and the taste of pure heavy water It might be mentioned in this connection that one cubic centimeter of water is not too small an amount to taste properly, since both of us could detect plainly the characteristic "flat" taste of distilled water in both cases It may be concluded, therefore, that pure deuterium oxide has the same taste as ordinary distilled water

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE CHOICE OF KILLING FLUIDS APPROPRIATE FOR CYTOLOGICAL RESEARCH

THE increasing use of cytological investigations by workers in the fields of physiology and pathology indicates that we have reached a point in biology where we are ready to use cytomorphological methods as an important adjunct to the study of function

One of the writers pointed out a quarter of a cen-

[1] SCIENCE, 77 427–428, 1933

[1] *Trans Wis Acad Sci*, 20 529–531, 1921, 23 249–254, 1927, 24 135–139 and 141–145, 1929

[2] SCIENCE, 80 531–533, 1934.

[3] *Wis Geol & Nat Hist Sur Bull*, 64 215, 1922

[4] *Bot Gaz*, 96 186–189, 1934

[5] SCIENCE, 52 641–642, 1920 *Trans Wis Acad Sci*, 20 521–527 1921, 21 381–414, 1924

tury ago that the essential living parts of the cell preserve their fundamental structure so long as the cell survives. The character which does change readily, either due to chromosomic constitution or to the agency of external factors, is the way the cell synthesizes or accumulates non-living constituents. Under favorable conditions a cell provided with the proper genes actively uses up the heterogeneous materials absorbed from the environment to build up homogeneous materials, which appear under the microscope as "optically empty" cytoplasm, mitochondria and "vacuolar sap." Under unfavorable conditions the homogenizing process is inhibited, resulting in the accumulation of unmetabolized products in the form of amino-acids, glucids or phenolic compounds in solution in the vacuolar sap, or as inclusions such as protids or lipids. In other cases, unused glucids accumulate as starch within the plastids.

Starch storage (which is concomitant with the differentiation of more mitochondria into amyloplasts) is correlated with inhibition of respiratory activity and a retarded rate of growth.

The results of modern cytological studies have shown that a living cell is not necessarily a physiological unit. On the contrary, metabolic processes utilizing the energy afforded by respiration probably take place mainly along the interphase between cytoplasm and vacuolar solution, and each of the "respiratory surfaces" within the cell may be differently affected by external stimuli, thereby producing a definite polarization within the living cell.

The total respiratory activity on an organism is the sum of the respiration on which depends the upkeep of the cell activity—maintenance—and of the respiration which provides energy for the syntheses within the growing cell. The former—the maintenance respiration—may proceed, although the latter—the growth-providing respiration—is inhibited by various agencies.

It is almost axiomatic that one who studies cytology should attempt to preserve the actual cell structure as well as possible. When studying cell morphology one should rely on the results of killing and staining methods only when he can check them through the observation of the living cell.

The killing fluid employed should, therefore, preserve as well as possible all constituents that can be seen in the living cell. It is especially important to preserve as much as possible of the apparent homogeneity of the cytoplasm, the clear-cut appearance of mitochondria and plastids, the outlines of the vacuoles and, above all, the products of cell metabolism. These results can be obtained only when the killing fluid penetrates the living tissues rapidly. Meves' fluid, which is admirable for some purposes, penetrates slowly. Tissues should be kept in Meves' for a week. It stains lipid inclusions dark brown and precipitates phenolic compounds as black bodies in the vacuoles, but may produce artifacts of a deceptive nature.

Nemec's killing fluid penetrates quickly, due to its formaldehyde content, and preserves the morphological integrity of the cell.[1] For the best results it requires a subsequent treatment in 3 per cent. potassium bichromate of at least 8 days to mordant the mitochondria and other constituents. Nemec's fluid precipitates phenolic materials as yellow flocculi, the consistency of which depends somewhat upon the concentration of potassium bichromate employed.

If principles like these were followed, investigators would soon cease to discuss the "good" or "poor" killing obtained through the use of mixtures containing acetic acid or alcohol, since they would realize that such mixtures so wreck the cell structure as to make any inferences drawn from the subsequent staining reactions void of significance.

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[1] H. S. Reed and J. Dufrenoy, *Amer. Jour. Bot.* In press.

ON THE MAPPING OF THE VELOCITY-POTENTIAL AND STREAM FUNCTIONS OF AN IDEAL FLUID

THE methods of Hele Shaw[1] and of Osborne Reynolds[2] in showing the form of the stream-lines about an obstacle are well known. Other methods have been developed by Relf[3] for ideal fluids and by Taylor and Sharman[4] for compressible fluids. Both of the two latter methods require rather elaborate set-ups of a more or less permanent nature, involving considerable apparatus. A modification of these methods, used by the writer in 1932–1933 in connection with some aerodynamic testing, proved quite helpful.

Acting upon the suggestion by Grillet[5] that sheets of conducting paper might be used to plot mathematically orthogonal functions, the writer has obtained satisfactory results, using in place of the usual liquid electrolyte an inexpensive black silhouette paper. The experimental procedure was, of course, identically the same as in the laboratory experiment showing equi-

[1] Trans. Inst. Naval Architects, p. 27, 1898; *Comptes Rendus*, 132: 1306–1312, 1901.
[2] *Phil. Trans. Roy. Soc.*, 1883.
[3] *Phil. Mag.*, 48: 535, 1924.
[4] *Proc. Roy. Soc.*, London, A 121: 194–217, 1928.
[5] *Comptes Rendus*, 194: 1464–1465, 1932.

potential lines and lines of flow of current, the ear phones and the alternating electric current being however, replaced by a galvanometer and by direct electric current

The velocity potential lines about the aerodynamic form were obtained by cutting out from the center of the conducting sheet the exact shape of the form the flow around which was to be studied and then mapping the electric equi potential lines, the latter corresponding to the velocity potential lines of a perfect fluid Lines drawn perpendicularly to these velocity potential lines gave the stream line flow about the obstacle Hence, a complete stream line pattern about an obstacle was obtained without even making a model of the obstacle

In mapping the stream line flow about a form directly, an accurate model of the obstacle, cut from a sheet of highly conducting material, was placed at the center of the conducting paper To insure that this model of the obstacle made good contact with the paper, small holes were drilled in the model whereby it was tacked to the table top

Quantitative results were obtained from the patterns by securing an equal drop in electric potential between all lines, this corresponding to an equal drop in the value of the velocity potential function or in the value of the stream function from line to line By means of the well known properties of these functions, the velocity at any point in the vicinity of the obstacle can be obtained in terms of the velocity at some point far removed from the obstacle This equal drop in the value of the functions between the lines was secured by keeping the fixed electrode in its original position on the first line and displacing the exploring electrode any arbitrary distance toward the obstacle, noting the galvanometer deflection The fixed electrode was then placed at the new position and the second line was plotted, the location of the fixed electrode for the plotting of the third line being obtained in the same manner as the corresponding point for the second line The potential difference between the terminals was kept constant, so that the deflection of the galvanometer had the same significance throughout the entire mapping operation

This method has the advantage that the pattern is obtained directly on the paper which serves as a record of the experiment This is made possible by using as electrodes two lead pencils, sharpened at both ends, one end being inserted into a short glass tube, and sealed therein with Kotinsky cement Mercury is poured into this glass tube and a wire is inserted from the top of the tube which is closed with a cork stopper, thus keeping the mercury from spilling and at the same time securely holding the wire in the mercury

The writer has made numerous patterns on paper about various forms Those forms for which the flow patterns are furnished by hydrodynamic theory yielded results in satisfactory agreement with the theoretical patterns and irregular forms yielded results which indicated the type of flow patterns which were later obtained in actual wind tunnel experiments The ground effect[6] has been obtained both by the reflection method and by the wind tunnel method of securing the effect by the introduction of a flat plate of large extent beneath the airfoil section, the flat plate being in this case simply one of the straight copper terminals Circulation effects can be obtained, as in Relf s method, by the application of an electric potential to the model of the obstacle

Although the paper gives sufficiently accurate results for laboratory instruction purposes, its irregularity reduces the accuracy of any quantitative determinations quite considerably If, instead of the paper, some thin, very homogeneous substance, such as stainless steel, is used, greater accuracy is possible

The writer has used a 1/32 inch thick sheet of stainless steel and has secured very accurate results With thinner sheets and a very sensitive galvanometer, exceedingly accurate mapping is possible

Albert C Erickson
Clark University

SPECIAL ARTICLES

DOES DILUTE HEAVY WATER INFLUENCE BIOLOGICAL PROCESSES?

In view of the appearance of a number of articles which describe stimulating action of dilute 'heavy" water on biological processes, we think that some results which we have obtained in this field may be of interest A summary of the published work has been presented by Barnes and Jahn[1]

The "heavy" water used in our experiments was obtained from the Ohio Chemical Company The original water was slightly cloudy, but was clear after an ordinary filtration The water was then distilled through two Pyrex glass systems fitted with efficient spray traps In each distillation the middle three fifths of the distillate was collected The second distillate, which was used for the experiments, was analyzed by means of an interferometer and was found to contain 0 46 per cent D_2O For the controls

[1] T C Barnes and T L Jahn, *Quart Rev Biol* 9 292–341, 1934

[6] E P Warner, "Aerodynamics," McGraw Hill, 1927

ordinary water, which contains 0.02 per cent. D_2O, was collected from a large laboratory still and was passed through the same stills that were used for the 0.46 per cent. D_2O. The 0.05 per cent. D_2O, used in several experiments, was prepared by diluting the 0.46 per cent. D_2O with the control water.

The growth of *Aspergillus niger* was studied by the method described by Mann.[2] Standard Pfeffer solutions, prepared with the 0.46 per cent. D_2O and the ordinary H_2O, were sterilized, inoculated and kept in an incubator at 34° C. for 5 days. At the end of this period all the mats were alike in appearance; they were slightly convoluted, and their fruiting was plentiful and uniform. The mats were washed, dried for 3 days at 65° C. and weighed. The dry weights are given in Table 1.

TABLE 1

GROWTH OF ASPERGILLUS NIGER[a]

Exp.	No. of flasks of each kind of water	Average weight of mats, grams	
		H_2O	D_2O
1	3	0.452 ± 0.027	0.435 ± 0.005
2	10	0.224 ± 0.029	0.229 ± 0.025
3	10	0.161 ± 0.023	0.181 ± 0.016

[a] In experiments 1 and 2, 0.46 per cent. D_2O was used; in experiment 3, 0.05 per cent. D_2O. In the first experiment 50 cc of solution were used in a 125 cc flask; in the others 15 cc in a 50 cc flask. Experiments 1 and 2 were performed by different workers. The precision given is average deviation.

It may be seen that we found no marked difference in the weights of the mats grown in the ordinary H_2O and in the 0.46 per cent. D_2O. The weights are of the same order of magnitude as those obtained by Mann[2] with ordinary water. Considering the percentage error in such work, the difference in the weights in experiment 3 is not to be regarded as significant. Thus, our results, in contrast to those of Meyer,[3] indicate no stimulating effect of dilute D_2O on the growth of *Aspergillus*. It should be pointed out that the D_2O content of the water in a Pfeffer solution is probably not the same as that of the original water, owing to the exchange of the D atoms with the hydrogen of the hydroxyl groups in the sucrose.

A study was made of the percentage germination of conidia of the powdery mildew of wheat, *Erysiphe graminis tritici*, incubated in hanging drops of ordinary distilled water and in two low concentrations of heavy water. The preparations were kept in darkness for 10 hours at 15° C. The results are shown in Table 2.

TABLE 2

GERMINATION OF CONIDIA OF ERYSIPHE GRAMINIS TRITICI AFTER 10 HOURS AT 15° C.

Culture medium	pH	Number of spores counted	Number of spores germinated	Percentage germination
0.05 per cent. D_2O	5.7	1127	616	54.7
0.46 per cent. D_2O	5.7	1078	591	54.8
Control (dist. H_2O)	5.7	1133	618	54.5
Control (nutrient soln.)	5.5	441	236	53.5
Control (tap water)	7.2	1145	851	74.3

In the tap water control at pH 7.2 about 99 per cent. of the viable spores (about 75 per cent. of the total number) had germinated after 10 hours at 15° C. The percentage of germination was considerably lower in the other preparations (at pH 5.5–5.7), but it was the same in the 0.05 per cent. and 0.46 per cent. D_2O as in the ordinary distilled water.

The growth of wheat roots in 0.46 per cent. D_2O and in ordinary distilled H_2O was also studied. The culture method was essentially the same as that described in a previous paper.[4] Seeds of Marquis wheat were soaked in the appropriate water for 3 hours and then germinated on moist filter paper at 28° C. until the primary roots were about 6 mm long (approximately 25 hours). Uniform seedlings were then placed on paraffined bobbinet so that their roots could grow downward into water contained in a beaker.

TABLE 3

ROOT GROWTH OF WHEAT SEEDLINGS IN 96 HOURS AT 19°–20° C. (EACH FIGURE REPRESENTING THE AVERAGE OF 25 ROOTS)

Exp.	Primary roots, mm		Lateral roots, mm	
	H_2O	D_2O	H_2O	D_2O
1	74.1	83.8	.. ..	..
	72.7	72.9	.. ..	.. ..
2	90.0	87.6	82.9	79.6
			85.4	79.2
	85.8	86.4	80.9	77.6
			81.3	78.8

[2] M. L. Mann, *Bull. Torrey Bot. Club*, 59: 443–490, 1932.

[3] S. L. Meyer, SCIENCE, 79: 210–211, 1934.

[4] S. F. Trelease and H. M. Trelease, *Bull. Torrey Bot. Club*, 53: 137–156, 1926.

Twenty five seedlings were used for each beaker, and in each experiment 50 seedlings were used for the 0 46 per cent D_2O and the same number for the H_2O The cultures were kept in darkness at 19°–20° C for 96 hours, and at the end of this period the roots were measured The results, shown in Table 3, indicate no significant difference in the effects of 0 46 per cent D_2O and ordinary H_2O on the root elongation of the wheat seedlings

The rate of the respiration of wheat seedlings at 28 5° C, as indicated by O_2 consumption, was measured by means of Warburg manometers The seeds were soaked in the appropriate water for 3 hours and then allowed to germinate for about 24 hours on moist filter paper at 28° C in a dark incubator At the end of this period there was no difference in the appearance of the seedlings Seedlings of the same root length were then placed on moist filter paper in the Warburg vessels In each experiment three vessels, each containing 8 seedlings, were used for the dilute D_2O and three for the ordinary H_2O

No difference was found in the rate of O_2 consumption by the seedlings in dilute D_2O and H_2O The plot of O_2 consumption against time for the seedlings in each vessel gave practically a straight line over the period of an experiment (approximately ¾ hour) In each experiment the six lines (three for dilute D_2O and three for ordinary H_2O) lay close to one another, in a random order The numerical data are given in Table 4

TABLE 4

OXYGEN CONSUMPTION BY WHEAT SEEDLINGS[a]

Exp	Root length of seedlings used, mm	O_2 consumption by 8 seedlings cmm/min	
		H_2O	D_2O
1	1–3	2 92	2 93
2	3–5	3 04	3 02
3	1–3	2 84	2 96
4	1 5–3 5	3 03	3 05
5	3 5–6	3 28	3 26
6	1–3	2 87	2 82

[a] The rate given is the average from 3 vessels, the average deviation being less than ± 4 per cent In experiments 1 to 4, 0 46 per cent D_2O was used in 5 and 6 0 05 D_2O In experiment 6 quartz sand was used instead of filter paper

These results may be summarized by saying that in the investigation of four biological processes—namely, growth of *Aspergillus*, germination of conidia of *Erysiphe graminis tritici*, root growth of wheat and O_2 consumption by wheat seedlings—no significant difference was observed between the influence of dilute heavy water and that of ordinary water

This work forms a part of a study made possible by a generous grant from the Rockefeller Foundation

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PITYROSPORUM OVALIS AS A CAUSATIVE AGENT OF SEBORRHEIC DERMATITIS

IT has been popularly considered by many dermatologists that *Pityrosporum ovalis*, the so-called 'bottle bacillus' of Unna, is the etiological agent of seborrhea capitis simplex (dandruff) and seborrhea corporis (scaling of the body) Unfortunately, the inability to grow the organism for any length of time kept the clinicians from proving this belief in compliance with Koch s postulates The organism is a yeast like, budding, non filamentous fungus, ovoid to spherical in form When seen in scales, the cells are usually bottle or gourd shaped, ovoid and thin walled, 2–4 × 2–3 µ in size or spherical and thick walled, 3–9 µ in diameter

Because of its supposed relationship to bacteria, early investigators used bacteriological media for cultivating the microbe, with no success Later workers, finding it to be a fungus, had somewhat better results using mycological substrates No one had been able to cultivate *Pityrosporum ovalis* beyond one or two subcultures One of the writers (Moore) inoculated fresh slants of wort agar (product of the Digestive Ferments Company), pH 4 8, with scales from scalps having seborrhea and was able to grow the fungus in approximately 12 per cent of the attempts (8 out of 90) The microbe was successfully subcultured and used in experiments to test its pathogenicity, or at least its rôle in seborrhea

Laboratory animals, including rabbits, guinea pigs, rats, white mice and hairless mice, were inoculated as follows Intradermally with a saline suspension, percutaneously (scratching the skin) with and without a lipid salve, cutaneously and controls Rabbits and guinea pigs gave favorable reactions with percutaneous inoculations Mice, rats and hairless mice were negative

A number of humans were inoculated as were the animals and, in addition, auto inoculations with scales from the patient's scalp were made on the chest and in the axillae The percutaneous inoculation with the application of whole culture of *Pityrosporum ovalis* produced seborrheic dermatitis in 50 per cent of the patients, while the same inoculation with the rubbing in of a lipid salve gave approximately 85 per cent reactions Intradermal injections produced a distinct erythema in approximately 75 per cent of the cases Cutaneous tests were not very convincing, while auto

inoculations were successful in 50 per cent of the attempts The controls were negative in over 90 per cent of the patients These results seem to indicate that *Pityrosporum ovalis* may produce seborrheic dermatitis under favorable conditions

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A DWARF MUTATION IN THE RAT

IN rodents genetic dwarfs have been reported in the guinea pig,[1 2] in the mouse by Snell[3] and recently in the rabbit by Green, Hu and Brown [4] The dwarfism in the mouse was shown by Smith and MacDowell[5] to be caused by a hereditary deficiency of the anterior pituitary Preliminary studies in the rabbit suggest that the defect may be due to an endocrine abnormality, while in the guinea pig the nature of the dwarfism was not determined

The dwarf mutation in the rat described herein was first observed in our colony in the summer of 1933 It appeared as one individual in a litter of nine young in a strain of rats that had been closely inbred in our laboratory for several years Shortly afterward another dwarf was observed in a litter from a closely related pair, and subsequently in the litters of other closely related rats At present 22 dwarfs have been produced in 12 litters the ratio of normal to dwarf in these litters being 80 to 22 These results suggest that the dwarf is the result of a simple autosomal recessive mutation, the appearance of both dwarf males and females showing that the gene is not sex linked

At birth normal and dwarf rats can not be distinguished and it is impossible to separate the dwarf rats with certainty until about the twelfth day after birth At this time a distinct difference in rate of growth becomes manifest, and the hair of the dwarfs appears much thinner and of finer texture than the hair on their normal litter mates This difference in the hair is a characteristic feature of the dwarfs throughout life The mature weight of the dwarfs is approximately 50 per cent that of the normal males and 70 per cent of the normal females of this strain A remarkable feature is the failure of the males and females to become differentiated in size, whereas the male normally becomes distinctly larger than the female

Thus far all dwarfs have proven to be sterile No sexual activity has been observed in dwarf males and in only one instance has copulation been noted among the dwarf females The size of the testes remains infantile, becoming less than one-half normal size Spermatogenesis occurs, but at a greatly reduced rate, and the few sperm observed were abnormal in appearance As yet studies have not been made of the ovary

In all cases so far observed a distinct opacity of the lens of the eyes has been associated with the dwarfism, although some variation in the degree of this opacity exists Skeletons of the dwarfs have not been prepared, but the general proportion of the body parts appears the same as in normal rats The effect seems to be a general reduction in size of all parts, and the retardation in rate of growth becomes manifest at a very early date Using the method of analysis of variance on the weights of litters in which dwarfs appeared, it has been determined that the retardation in growth had begun on the fifth day As pointed out above, however, individual dwarfs can not be separated with certainty until about the twelfth day after birth The dwarf rats are weaker than normals are more susceptible to infections and are shorter lived

Individuals heterozygous for the dwarf gene are normal in appearance, in vitality and they attain the same size as homozygous normal rats Recently, however, some individuals have been observed among the progeny of dwarf producing pairs that were slightly slow in developing their hair and whose early growth seemed somewhat retarded Tests are now under way to determine whether such individuals are heterozygous for the dwarf gene

The decreased size of the dwarf rats, their sterility and their general appearance suggests that the defect may be of endocrine origin It is, however, apparently not due to a pituitary deficiency, since in preliminary tests with the implantation of pituitary bodies from normal rats, following the technique of Smith and MacDowell, growth was not produced in treated dwarfs Further experiments to determine the physiologic cause of this dwarfism are at present under way and the colony is being expanded in order to insure a constant supply of the dwarfs

W V LAMBERT
A SCIUCHETTI

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SCIENCE

VOL. 81 FRIDAY, MARCH 22, 1935 No. 2099

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

NEUROHUMORS: NOVEL AGENTS IN THE ACTION OF THE NERVOUS SYSTEM[1]

By Professor GEORGE HOWARD PARKER

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THE enunciation of the neurone theory by Waldeyer in 1891 was a fitting culmination of the neurological work of the nineteenth century. By means of it many detailed questions on the structure and the function of the nervous elements found satisfactory and final answers, but as a result of it there also arose a host of new and perplexing problems, many of which are still unsolved. Prominent among these is that concerning the relations of nerve-cells or neurones not only among themselves but also between them and the cells of receptor and effector organs.

Embryonic nerve-cells or neuroblasts are at the outset reasonably separate and independent entities without special functional interdependence. As they grow and differentiate they come to form systems of conducting pathways by which one remote part of the body is brought into nervous connection with another. How neurones are related in such conducting systems has been a matter of dispute. Some histologists have claimed that the processes of one neurone fuse with those of the next and thus establish possibilities of nervous conduction; others have declared that such processes are only in contact one with another. The importance of this question disappeared, however, when it was found that degenerative changes started in one neurone never pass over the assumed boundary into the next neurone and that nerve impulses, which may course in either direction up or down a neurone, are limited to one direction in passing from neurone to neurone. Thus, whether neurone tips are fused with each other or are merely in contact, their region of joining, the so-called synapse, must be a differentiated area polarized as to its direction of transmis-

[1] An address given at the annual meeting of the Worcester Chapter of the Sigma Xi, on November 5, 1934.

sion Thus in a way the old and rather discredited law of forward conduction' receives a certain restricted justification

The capacity of the synapse to limit the direction of transmission has often been compared to the action of a valve But this is obviously a figurative statement, for the nerve impulse is not a gush of fluid through a tube whose direction of transmission is controlled by valvular devices What, may we ask, is it that passes over the synapse? Two possible answers to this question have been put very clearly by Gerard, who has stated that either the same kind of ion migration and chemical change which represents the impulse itself passes over the synapse from neurone to neurone or the terminals of the discharging neurone act as miniature glands and, when stimulated produce some chemical which is able to excite the tips of the next neurone and thereby initiate another impulse Since the first of these hypotheses offers no explanation for synaptic polarization, while the second does modern opinion has drifted consistently toward the latter This view implies a chemical interpretation of the interaction of nervous elements a view which in a certain measure was long ago advocated for sense cells and their conducting elements by Botezat It is to be met with continually in the writings of the late Ramon y Cajal and has been suggested for central organs by Sir Charles Sherrington and his associates The chemical substance produced in this assumed activity, whereby one neurone may excite a neighboring neurone or other appended cell has been called a neurohumor to use a term introduced some years ago by Henri Fredericq Such substances include in my opinion not only materials like acetyl choline as recently discussed from this standpoint by Sir Henry Dale and his fellow workers and Cannon's sympathin but also adrenalin and those products of the pituitary gland which are known to activate animal effectors

Neurohumors may act over distances of microscopic if not ultramicroscopic proportions or over large ranges in the animal body Such substances irrespective of their extent of spread, are in principle nervous activators and their grouping under one head namely, that of neurohumors, is fully justifiable Some students of this subject would class all neurohumors as hormones, others would include under this heading only such as act over long distances but this does not seem to me to be a matter of serious import Neurohumors really act as hormones over shorter or longer ranges The precise problem that we have to face is not the classification of neurohumors, but the extent to which these substances actually exist To that question we may now address ourselves, and in approaching it I shall deal chiefly with the nervous control of the melanophores in fishes

In 1876 Pouchet showed that if the integumentary nerves of a turbot are cut, the denervated area of skin thus produced becomes dark through the dispersion of the melanin granules contained within its melanophores The nerve fibers concerned in this operation were shown to be autonomic in origin Their great abundance and button like terminals were demonstrated in a number of fishes by Ballowitz in 1893 As a result of these discoveries the nervous control of melanophores in fishes was accepted by practically all workers in this field, a conclusion amply supported by the later exhaustive investigations of von Frisch The neurohumoral interpretation of these results is to the effect that the nerve terminals applied to the chromatophores do not excite these cells directly, as is generally believed but that these endings secrete a neurohumor which on reaching the color cells induces them to respond in an appropriate way Is there any evidence that such neurohumors play a real part in the color changes of fishes? A test of this question has been attempted on the common killifish *Fundulus heteroclitus* which has well marked dark and light phases

If a small transverse cut about a millimeter in length is made through a single fin ray near the root of the tail of a light Fundulus small bundles of radial nerve fibers going to a restricted part of the tail will be severed and the denervated area thus produced will become evident as a dark, radiating band extending from the cut to the posterior margin of the tail Such a band will begin to appear in about half a minute after the cut has been made and will grow in intensity for a short time, after which it may remain visible for several days Under the microscope the band can be seen to be made up of melanophores whose pigment is fully dispersed, a condition in strong contrast with that of the color cells in the rest of the tail where the melanin is densely concentrated near the cell centers

Such a dark denervated band will maintain itself for as much as several days, even though the fish on which it has been formed is kept in a white walled, illuminated aquarium, a condition under which the light coloration of the fish as a whole is retained Gradually, however, the band begins to blanch and sooner or later it disappears by taking on the light tint of the fish Bands of this kind may be called primary bands

If such a light fish with a completely or nearly completely blanched primary band is put in a black walled, illuminated aquarium, the fish, with the exception of the band, turns dark in less than two hours The band though denervated, then also darkens but only gradually and finally in a little less than a day it becomes as dark as the rest of the fish The converse

change follows a corresponding course When a dark fish with a denervated band in its tail is put into a white walled aquarium, the fish as a whole blanches in rather less than five hours and the band in a little over a day Bands either light or dark that are produced after the initial or primary band has disappeared may be called secondary bands and such bands change with the changes in the surroundings as the body of the fish does but with a very considerable lag

When the fading of a primary band is followed in detail, it is seen that the band does not blanch uniformly and as a whole, but it begins to disappear first on its edges, as pointed out several years ago by Mills, and this process gradually spreads towards its axis, which is the last part to fade The disappearance and reappearance of secondary bands also take place by lateral disintegration According to the neurohumoral hypothesis this process is to be understood as a response on the part of the denervated band to materials produced in the adjacent innervated portion of the tail These materials make their way gradually from the regions of their origin into the band and thus effect a change in the melanophores there corresponding to that seen in the innervated area In fact, it seems to me very difficult to explain these changes in any other way It is well known, for instance that these changes can have nothing to do with the possible degeneration or regeneration of the local nerve fibers, for it has been shown that these fibers do not degenerate till some twelve days after they have been cut and that they regenerate in only about twenty to twenty five days after this operation The disappearance and reappearance of the bands as already described, may be excited any time after the blanching of the primary band, that is, after two or three days following the exciting cut That the nerve fibers in a blanched primary band are still fully active can be shown by recutting such a band in a region slightly distal to the initial cut By this means the band may be fully revived from the new cut to the free edge of the tail showing that in its blanched condition the nerves in the band have gone into a temporarily quiescent state and are in no sense degenerated

The primary band is apparently due to nerve impulses which for a time after the initiating cut has been made emanate from that region and excite the more distally located melanophores to disperse their pigment If such an assumption is correct, it ought to be possible by an appropriate block to intercept such impulses and thereby obliterate the band The most appropriate means of doing this is cold If a capillary glass tube carrying dilute alcohol chilled to a degree well below 0° C is applied to a fairly mature primary band, the distal part of the band that is separated from the cut by the tube soon blanches This response justified the view that the band is dependent upon a flow of impulses from the region of the initiating cut

How these impulses are produced is not easily stated Since in the normal locomotion of the fish the tail is more or less continuously moved from side to side, it might be supposed that the friction thus generated in the cut would be the means of exciting impulses If, however, in place of the usual small transverse incision in the tail, a square window is cut therein whereby the cut faces of the wound are no longer capable of rubbing one against the other, the band will nevertheless appear It must therefore be admitted that the nerve impulses that call forth the band are not the simple result of the rubbing of the faces of the wound How these impulses originate can not be stated Probably they are dependent upon some more subtle form of stimulation in the cut for it seems clear that the primary band is due to a flow of impulses from the cut region to the more distal melanophores With the subsidence of this excitation the primary band gradually disappears a step much in advance of the degeneration of the nerve fibers in the region concerned

After the disappearance of the primary dark band the revival of bands which resemble but lag behind the bodily color changes have been ascribed to neurohumors and presumably to two sets of these substances one exciting a concentration of melanin in the containing cells and the other its dispersion This interpretation suggests double innervation for these cells, a belief that is substantiated by the fact that when the exact areas of a given dark band and of its light equivalent are accurately compared, they are found not to agree precisely (Mills) This state of affairs is difficult to understand except on the assumption of a double set of nerve fibers, one for pigment concentration and the other for its dispersion

If two sets of nerve fibers are present for the melanophores in Fundulus, two sets of neurohumors are to be expected Evidence in favor of the duplicity of these agents is afforded by experiments with flanking dark bands Such experiments are best seen in the tails of the catfish Ameiurus though they can be demonstrated in the tails of other fishes such as Fundulus If two short, initial dark bands are produced in the tail of a light catfish and in such positions that an intervening band of innervated tissue is left between them, the flanking bands of course darken, the area between them, however, remains light If now the same test is tried but with a difference that the intervening band is a denervated blanched one and the dark flanking bands are short ones and of such a length as to abut only the distal half of the blanched

band, this band in a short time shows a remarkable state Its proximal half, that which adjoins the light area of the tail, remains light, while its distal half, flanked by the newly formed dark bands, becomes conspicuously dark From these experiments two conclusions can be drawn first that from the dark flanking bands something makes its way into the denervated light band and darkens it a dispersing neurohumor, and second, that an innervated light band can resist this darkening by something produced by its nerve fibers, a concentrating neurohumor It seems highly probable, therefore, that there are not only concentrating and dispersing nerve fibers but also corresponding neurohumors

The spread of these neurohumors over the millimeter or two of integument which may constitute the width of a band is from the side of the band inward toward its axis This spread takes place at a very slow rate the whole operation often requiring as much as a day This slow axial spread makes it very improbable that the transfer of the neurohumors is by means of the blood and lymph of the given region That blood and lymph are not concerned in this operation is shown in at least two ways If adrenalin is injected into a Fundulus with a dark caudal band, this band disappears within less than a quarter of an hour and disappears as a whole, not by disintegration from the sides This type of disappearance is what would be expected from a neurohumor carried in the blood for the whole undersurface of the band is open to approach from the circulatory system Further, as Matthews has recently shown the blood from a dark Fundulus does not produce a dark spot when injected into a light Fundulus and *vice versa* From these two standpoints it, therefore seems clear that if neurohumors are produced by the melanophore nerves in Fundulus these are not transmitted to the color cells by the blood They are probably not water soluble That they do make their way across the millimeter or more of denervated skin in the band can not be doubted Hence it is concluded that they must be carried by some other solvent than water I have expressed the opinion that they are soluble in oil and that they are transmitted from cell to cell by the fatty or lipoid constituents of these bodies Such a means of transmission is quite consistent with the facts that have been learned concerning the appearance and disappearance of caudal bands, particularly the lateral decay of these bands and their notable lag behind the color changes of the fish as a whole

A conclusion such as that just arrived at naturally raises the question of evidence for or against oil soluble neurohumors An attempt to ascertain whether there are such neurohumors has been made on the common dogfish, *Mustelus canis* This fish, like Fundulus, has two well marked color phases, one dark and the other light As might be expected, the dark phase results from the dispersion of melanin in the dermal melanophores and the light one from its concentration As Lundstrom and Bard showed in 1932, when the pituitary gland of a dogfish is removed the fish becomes permanently light-tinted On injecting a water extract of the gland into such a light fish the dark phase is temporarily reassumed Moreover the injection of defibrinated blood from a dark fish into a light one produces a temporary dark spot about the region of injection These facts led Lundstrom and Bard to conclude that the dark phase of Mustelus is due to a substance produced in the pituitary gland and carried from that gland in the blood of the animal to its dermal melanophores

Two years later Parker and Porter showed that when the integumentary nerves of a dogfish are cut the denervated area thus produced becomes very light, even lighter in tint than that of the ordinary light dogfish It, therefore appears that in the dogfish although the dark phase is produced by a dispersing neurohumor carried in the blood the light phase is a nerve response of strictly local occurrence The question naturally arises, Is there a neurohumor associated with this light phase? As has already been indicated when the defibrinated blood of a light dogfish is injected into a dark one no color change can be detected Hence if the light phase is induced by a neurohumor the neurohumor involved since it is not carried in the blood is probably not soluble in water Is it soluble in oil? To test this question the fins of a light dogfish the most responsive parts of its body, were reduced to a pulp by grinding them in a pulping machine This pulp was then extracted with pure Italian olive oil The oily residue thus obtained was injected with proper precautions into a dark dogfish, which in course of time showed a striking light spot near the region of injection Under the microscope the melanophore pigment in this spot was seen to be concentrated in the color cells a condition that could be temporarily overcome by the injection of pituitrin into the animal Light spots of the kind described did not result from simple oil injections An ether extract of the fins also induced the formation of light spots in the fish Extracts from fresh fins or from fins that had been dried for over a day at 110° C were equally effective These observations support the conclusion that in Mustelus beside the water-soluble pituitary neurohumor by which the melanophores are induced to disperse their melanin and thereby darken the fish, there is also an oil-soluble neurohumor that is equally effective in bringing about pigment concentration This at least seems reasonable in view of what has already been described for the

concentrating neurohumor of Fundulus. These studies on the so-called nervous control of the melanophores of fishes point with great certainty to neurohumors as the agents really concerned and suggest the probability that there are two classes of such agents, one of which consists of materials, like pituitrin, soluble in water and hence transportable by the blood, hydroneurohumors, and the other soluble in oil and hence transmissible through the fatty or lipoid constituent of the tissues, liponeurohumors.

Although the instances here discussed are taken from only a single group of effectors, chromatophores, and their nervous connections, it is possible that reactions of this kind extend throughout the whole of the nervous organization of animals and that the relation of receptor cells to neurones, of one neurone to another, as well as of neurones to effectors may be based upon the same principle that appears to apply to chromatophores. This in fact is the neurohumoral hypothesis, a view which in its essence has been expressed already by a number of workers and which under the general caption of the chemical interrelation of nervous elements has permeated the thinking of not a few of the neurologists of to-day.

THE UNSOLVED PROBLEMS OF LEPROSY[1]

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THE earliest medical records from Egypt and India are said to include descriptions of clinical leprosy.[2] Although the somewhat indeterminate description of cutaneous ills summarized in the term "zaraath" in the Old Testament may well have included several separate entities, there is every reason to believe that it was incidentally descriptive of the disease now known as leprosy. The horror, fear and pity which leprosy in its exaggerated forms have always excited led to early attempts at segregation of its sufferers in many places. At all events the modern clinical description of leprosy dates from the work of Danielssen and Boeck in 1847. It seems certain that Hansen in 1868, and even before he had anilin dyes to use, actually described with fidelity the massive aggregates or globi of the leprosy bacillus which we now recognize as a constant feature in the cutaneous form of the disease. In spite of these two relatively early evidences of objective certainty, the history of leprosy as a process remains in many of its significant phases as baffling to-day as it was a century ago. It may well take all the short time placed at my disposal to list with anything like sequential probability what the outstanding and unsolved problems of leprosy are, but this, at least, I shall attempt to do, with the further hope that I may emphasize two of the main junction points in the historical pathway which this brief survey covers.

It is still uncertain precisely what effect the segregation of lepers has had in suppressing the disease. Such isolation can never be completely carried out, particularly under the conditions of living in those countries where it is most prevalent, and a belief in its effectiveness is based largely on the disappearance of leprosy from Continental Europe in the Middle Ages, although certain other factors such as other decimating epidemics, changes in dietary and even of climate, may well be involved. At all events the disease still remains in precisely those localities of the world where it was first described in Africa, in the Orient and in the West Indies. Until we know more fully the precise epidemiology of leprosy no process of segregation could be expected to be efficient.

There is no question as to the great prevalence of leprosy in the early years of life, and the modern trend of thought goes farther in believing that infection takes place, at least in the majority of instances, in these very same early years, irrespective of the precise time of its clinical detection. We would not go so far as does Manalang who in view of the slow development of the disease and its frequent spontaneous cure in children before the complete evolution of the disease would deny the possibility of its inception in adult life. In fact, there are recent well controlled instances of accidental and experimental infection which render it probable that natural adult infection normally, although perhaps rarely, occurs.[3]

Far too little attempt, it would seem to us, has been made to ascertain the possibility of eliminating leprosy by immediate segregation at birth. Most of the references on the effect of removing the offspring of leper parents are misquoted and deal rather with separation at varying periods after birth than at the moment of delivery. The extraordinarily important results reported by Hasseltine in Honolulu have not, so far as we are able to determine from the literature, or on direct inquiry from those most concerned, been followed up. It will be recalled that Hasseltine found

[1] Address delivered before Section N—Medical Sciences, American Association for the Advancement of Science, Pittsburgh, December 31, 1934.

[2] Rogers and Muir.

[3] deLangen, Marchoux.

a single case of leprosy over a period of fifteen years in 219 children who had been removed from their leper parents at birth. In further investigation of these results, and in their prompt general application if they are confirmed, lies in our mind the first important pathway toward the eradication of the disease.

One of the most striking features of leprosy is its differentiation into types which may be so extreme as to justify a restricted diagnosis of the disease as "neural," 'cutaneous" or finally "tuberculoid." All combinations of these extreme forms exist and they are all apparently preceded by the identical primary lesion. The several forms furthermore markedly predominate in certain countries, for example, although *all types exist in the United States, on the other hand* the cutaneous form is almost exclusively seen in the Philippines, and the neural form bulks large in India.

These clinical forms of the disease are extremely divergent in their individual pathology and these differences are marked particularly by the almost complete absence from the neural form of the enormous numbers of acid fast bacilli which are constantly present in the moderately advanced cutaneous disease. Diagnosis, indeed, in the neural form is often difficult owing to the absence of the characteristic bacteria which facilitate recognition of the cutaneous form. One may well speculate as to this diversity of clinical types which involves not only geographical distribution conceivably owing to differences in climate, and which is also accompanied by marked differences in spontaneous cure the neural form being on the whole milder and more frequently recoverable. This leads us directly to a consideration of the etiological agent of the disease itself.

We have already referred to the enormous aggregates of acid fast bacteria that are found in typical cutaneous cases of leprosy but non acid fast and even branching forms and forms like the Much granules in tuberculosis have also been casually observed. These latter forms might seem more significant if they were diligently sought for and it is not inconceivable that their relation to the neural form is an important one.

A series of observers since Neisser, nearly fifty years ago (1886), aggregating well over 60 authors or groups of authors to date and involving many more separate publications, are readily to be found in literature. Each of these authors in turn has believed that he alone has isolated the true organism of leprosy and feels that each of his predecessors has at best been only partially successful in attaining the desired result. A recent critical survey of this baffling question has led us to a belief somewhat different from the usual accepted one, namely, that a number of these observers have in reality grown the specific microorganism, rather than the generally accepted view that no one or only one particular investigator has as yet been successful. We should be embarrassed to attempt to name all these isolations which we should regard as etiologically correct. One is inclined at first glance to rule out the numerous observations which impute etiological significance to Gram positive non acid fast diphtheroids if it were not for two main lines of argument. It is true that such organisms are readily found in the normal skin. On the other hand, it is certain that acid fast contaminants might also be present.

In at least 18 instances in the 68 separate descriptions of isolated organisms that we have found and studied, diphtheroids have been described, and some of these by investigators whose previous work would inspire technical confidence. Both chromogenic and non chromogenic acid fast organisms have been obtained in 32 instances, and in view of the recent work on chromogenic variants of the tubercle bacillus now clearly established, there is no inherent reason why any of these isolations should not represent the true etiological agent. We must confess here to an early prejudice. Studies on organisms of the Actinomycetales group by our regretted pupil, Edith Claypole, showed in no uncertain fashion that in her unusual collection of pathogenic members of this genus, as studied over a period of years, individual pure strains not only varied from acid fast bacilli to non acid fast Gram positive organisms, but further to branching non acid fast forms. Furthermore, all these varieties were observed in many single strains when studied at intervals over a long period, and cross immunity reactions were shown to occur between the divergent morphological forms. With this in mind we are receptive to the claims of those 11 investigators who have isolated what they have described as a 'streptothrix" in cultures from leprosy as well as those 18 others who found diphtheroids. Some of these cultures were variably acid fast and even branching. A few authors have described both acid fast bacilli, non acid fast diphtheroids and acid fast streptothrix in successive isolations.

May we make our position perfectly clear in this matter by quoting a few specific references? We have personally no reasonable doubt that the non chromogenic acid fast bacillus isolated by Soule and McKinley, and which retains these characteristics, is the one that is present in characteristic fashion in cutaneous leprosy. But we feel also that it is quite likely that the diphtheroid isolated by Walker, at times, may represent another growth phase of the acid fast organism which he also found. Salle's recent claim at transformation of a primary acid-fast isolation into a diphtheroid on subculture would,

if corroborated, prove this suggestion of various growth phases, which, to repeat, is not confined to the organism of leprosy

The final and crucial proof of the correct etiological agent of leprosy still remains to be fulfilled One spontaneous disease in animals, rat leprosy, apparently offers almost complete analogy to the human syndrome, including difficulty in culture of the microorganism in the lesion In spite of this fact no one has, we believe, produced experimental leprosy in animals with material of human origin with anything like fidelity No particular surprise need be occasioned by this failure Many strictly human diseases have not been reproduced in animals, and some have succeeded only on the inoculation of anthropoid apes which have not been sufficiently tested in the case of leprosy The time element would seem to us important in this connection We know that human leprosy often requires years after the presumed, or, in a few instances, the known time of infection, before characteristic lesions with bacteria in them are found, so far as we know no experimental animals have been observed longer than a few weeks

Another field for serious inquiry, in fact, the ultimately most important one in the study of leprosy, is that of specific therapy There is a firm, and we believe an increasing conviction, that chaulmoogra oil derivatives are to a variable degree effective at least in ameliorating the symptoms and lesions of leprosy The effectiveness so far depends not only on the preparation used but on the method of inoculation, and human trial must remain the ultimate criterion on which this or any other form of therapy is based But it would seem as if a fairly obvious experimental method for the testing of the comparative value of anti leprosy medicaments has only recently been tried, Anderson and his collaborators have compared several derivatives of chaulmoogra oil on rats spontaneously suffering from their own variety of leprosy and have been able to come to a certain decision in reference to the best of these preparations Surely further attempts in this direction are indicated

SCIENTIFIC EVENTS

THE FOURTH INTERNATIONAL CONGRESS OF AGRICULTURAL INDUSTRIES

THE fourth International Congress of Agricultural Industries, which is one of the many to be held in connection with the Brussels Universal Exposition of 1935, is being organized by the International Commission of Agricultural Industries

It will be remembered that the third congress was held in March of last year, at Paris, and although intervals of three years between the congresses will ordinarily be observed, it was decided to hold the next one the following year in order to set up a more effective organization of the congresses and to take advantage of the Brussels exposition

The congress will be organized in the four divisions (1) General scientific studies, (2) Agronomic studies, (3) Industrial studies, and (4) Economic studies There will be some twenty six sections comprised in these four general divisions In order to assure that subjects of timely interest are discussed, special reporters upon ten such topics will be appointed and the reports prepared by them printed and distributed in advance in order to assure fruitful discussion of these questions of "priority"

Communications are invited from all who may desire to take part in the program The texts of communications in triplicate, together with brief abstracts, should be mailed before April 15 The membership fee is 100 French francs and for the families of members, 50 francs Applications for membership and for further information should be addressed to the International Commission of Agricultural Industries, 156 Boulevard Magenta Paris (X) France

THE PAN AMERICAN INSTITUTE OF GEOGRAPHY AND HISTORY

A GEOGRAPHICAL and historical congress to organize an international bureau for the compilation of data on exploration was proposed by several South American countries as long ago as 1903 In 1928 at the sixth International Conference of American States plans were perfected for the organization of a Pan American Institute of Geography and History Sr Pedro C Sanchez was appointed director of that institute, and in September, 1929 a meeting to conclude plans of organization was held in Mexico City At that meeting Dr Lawrence Martin, of the Division of Maps of the Library of Congress Dr George B Winton, professor of history at Vanderbilt University, and Dr William Bowie, chief of the Division of Geodesy, U S Coast and Geodetic Survey, represented this nation

The first formal assembly of the institute was held at Rio de Janeiro in December, 1932 At that assembly the United States was represented by Hon Edwin V Morgan, Ambassador to Brazil, and Dr Wallace W Atwood, geographer, president of Clark University, Worcester, Massachusetts At the final plenary session the City of Washington was selected as the place for the next meeting in 1935, and Dr Atwood was chosen executive president for three years

Several of those who are particularly interested in

the development of cultural relationships between the citizens of the United States and their Latin American neighbors to the south, have held informal conferences in Washington and made preliminary plans for the congress, which is to be held in Washington before the close of this year Bills have been presented in both houses of the Congress in support of this enterprise On February 19 Secretary of State Cordell Hull sent the following letter to the President of the United States

Sir The undersigned, the Secretary of State, has the honor to recommend that the Congress be requested to enact legislation providing for an annual appropriation of $10 000 for the payment of the share of this Government in the expenses of the Pan American Institute of Geography and History to request the President to invite the Pan American Institute of Geography and History to hold its second general assembly in the United States in 1935 and to provide an appropriation of $10,000 for the expenses of such a meeting

There is attached hereto a statement containing the history of the Pan American Institute of Geography and History

Membership of the United States in the Institute would be desirable as the Institute will provide an international agency for the collection coordination and dissemination of geographical and historical information which will be of value to numerous organs of the Government of the United States scientific organizations, educational institutions and interested scholars

This is the first organization of a Pan American character to be established in Mexico The Mexican Government has made generous provision for the Institute including the erection of an appropriate and handsome building for its use The next meeting of the assembly of the Institute is scheduled to take place in Washington in 1935 It is believed that Mexico as well as the other members of the Pan American Union would view with great gratification the support of the Institute by the United States

On February 20 President Franklin D Roosevelt sent the following message to Congress

I commend to the favorable consideration of the Congress the enclosed report from the Secretary of State with an accompanying paper, to the end that legislation may be enacted providing for an annual appropriation of $10,000 for the payment of the share of this Government in the expenses of the Pan American Institute of Geography and History and requesting the President to invite the Pan American Institute of Geography and History to hold its second general assembly in the United States in 1935, and providing an appropriation of $10,000 for the expenses of such a meeting

If and when the Congress has taken the necessary action, the invitations will be sent out by the President, or through officers of the State Department, to the various nations that are cooperating in this enterprise and a group of official delegates will be selected to represent the United States at the coming meeting Preliminary plans call for a series of programs of general interest, in which progress in research work in geography and history and plans for cooperation between the American people in the promotion of such research will be presented We anticipate that a number of sectional meetings will be necessary, for the organization recognizes the fields of archeology, pre Columbian history, the Colonial epoch, as well as topography, cartography, geodesy, geomorphology, human geography, historical geography, biologic and economic geography

In addition to the formal meetings, at which papers may be presented, a number of excursions to places of special interest in or near Washington will be planned for the delegates It is anticipated that there will be one or two social occasions associated with the congress

WALLACE W ATWOOD, *President*
Pan American Institute of Geography and History

THE LANCASTER BRANCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AT a meeting of the executive committee of the American Association for the Advancement of Science held in New York on October 21, a committee was appointed with special reference to the organization of local branches of the association, and the first branch under its auspices authorized by the council at the Pittsburgh meeting of the association has been established at Lancaster, Pa

A preliminary organization meeting, with seventy of those interested in the movement in attendance, was held at Franklin and Marshall College in December Jaques Cattell, vice president of the Science Press Printing Company after stating briefly the object of the meeting introduced Dr Otis W Caldwell, professor of education and director of the Institute of School Experimentation at Teachers College, Columbia University, chairman of the committee on organization and now general secretary of the association Dr Caldwell gave an account of the work for the advancement and diffusion of science of the association and described how its objects could be promoted by the establishment of local branches As the result of the discussion following Dr Caldwell's address, which was led by Dr Paul L Whitely, professor of psychology at Franklin and Marshall College, acting as temporary chairman, a committee on organization was appointed

The first regular meeting was held on February 13, at Franklin and Marshall College, at which Dr W F G Swann, director of the Bartol Research Foun-

dation of the Franklin Institute, was guest lecturer He spoke on "Cosmic Rays Simplified" before an audience of approximately four hundred and fifty people Following the lecture he gave a cello recital of six numbers accompanied by Dr Barrows Dunham, assistant professor of English at Franklin and Marshall College Before the lecture a dinner was given in honor of Dr Swann, at which fourteen members especially interested in the success of the branch were present

The following officers were elected *Chairman,* Jaques Cattell, *Vice chairman,* Dr Clarence C Vogt, *Treasurer,* Professor H M Fry, *Secretary,* Dr Frances A Coventry Dr Noel P Laird was made chairman of the publicity committee This committee is composed of representatives from the Hamilton Watch Company, the Lancaster City Schools, the Lancaster County Schools, the Millersville State Teachers College, the Armstrong Cork Company, the Lancaster Medical Societies, the Lancaster College Club, the Harris Dental Society, the Muhlenberg Botanical Society and other organizations

One hundred and two members had joined the branch at the time of the meeting Since then the membership has increased to almost four hundred Dues have been set at $1 per year, and it is planned to hold meetings monthly from September to June

The second meeting was scheduled for March 20 with William McAndrew, formerly superintendent of schools in Chicago, as the lecturer The third meeting is planned for the second week in April, when the speakers will be M and Mme Jean Piccard

F A COVENTRY,
Secretary

THE ENGINEERING INDEX

DR FRANK B JEWETT, president of Bell Telephone Laboratories and vice president of the American Telephone and Telegraph Company, has accepted the position of national chairman of a campaign to raise a working capital fund of $161,000 for "Engineering Index, Inc" Announcement of Dr Jewett's acceptance was made by Collins P Bliss, president of the index and dean of the School of Engineering of New York University, who has headed a movement to save the fifty-year-old index and annotating service of the engineering profession since it was discontinued as an activity of the American Society of Mechanical Engineers a year ago In accepting the chairmanship of the Engineering Index National Committee, Dr Jewett said

Only my deep concern for the preservation of this essential service could induce me to accept this responsibility The keeping of the records of science is one of the most important and valuable activities To day the index is the only agency which makes available to the engineer and research worker an exhaustive and continuing record of findings and developments in the technical field

In view of the enormous, unwieldy mass of current engineering literature the absence of such a service would have serious and far reaching consequences Certainly if duplication of effort and the resulting economic loss is to be minimized, it is essential for the research worker at all times to be in a position to profit by what others have done and are doing

During the past year the continuance of *Engineering Index* as a non profit corporation has been the concern of a small group of educators and engineers The majority utilizing its service have taken such continuance for granted It is my belief that if representative members of the profession and of industry are apprised of the actual situation they will cooperate in providing funds needed to insure its permanence and make possible a program to widen its use

I join with Dean Bliss and the others on the National Committee, in the belief that preservation of *Engineering Index* is one of the most important jobs confronting the profession to-day Soundly established with adequate facilities for the exhaustive and systematic annotating and reporting of the findings in both pure and applied science, it will be insurance of continued and orderly progress, and as such a national asset Its support by industry is a matter of enlightened self interest

The National Committee is not as yet completely enrolled It, however, already includes the names of a large number of those prominent in engineering and in industry

RECENT DEATHS

DR JOHN JAMES RICKARD MACLEOD, professor of physiology in the University of Aberdeen, died on March 16, at the age of fifty eight years Dr Macleod, who received the Nobel prize with Sir Frederick Banting for their discovery of insulin, was professor of physiology at Western Reserve University from 1903 to 1918 and for the next ten years at Toronto

DR JOHN RUHRAH, professor of the diseases of children at the University of Maryland, died on March 10 at the age of fifty eight years

DR DANIEL COLQUHOUN, emeritus professor of medicine in the University of Otago, New Zealand, died on February 17

Nature records the death of Professor Emanuele Paterno, formerly professor of general chemistry at the University of Rome, and of Dr Axel Wallén, director of the State Meteorological Hydrographic Institute of Sweden

SCIENTIFIC NOTES AND NEWS

THE annual stated meeting of the National Academy of Sciences will be held under the presidency of Dr. W. W. Campbell, in the building of the academy at Washington, on April 22, 23 and 24. The autumn meeting will be held at the University of Virginia on November 18, 19 and 20.

THE spring meeting of the Executive Committee of the American Association for the Advancement of Science will be held in New York City on April 14. Communications to be brought to the attention of the committee should be sent to the permanent secretary, the Smithsonian Institution Building, Washington, D. C.

DR. FREDERICK G. NOVY, retiring dean of the University of Michigan Medical School, at a special executive faculty meeting on February 7 was presented with a bronze plaque. The resolution inscribed on the plaque acknowledged Dr. Novy's years of service to the university and noted the regret of his colleagues that he will no longer be associated with them. Dr. Novy is succeeded as dean by Dr. Albert C. Furstenberg.

ON the occasion of his retirement on March 15 as Governor General and Commander in chief of New Zealand after five years of office, Lord Bledisloe presented to the Dominion a portrait of Lord Rutherford, a native of New Zealand, painted by Oswald Birley, also a New Zealander. The portrait will be hung in the new National Art Gallery at Wellington. Mr. Birley painted some three years ago a portrait of Lord Rutherford, which was presented to the Royal Institution and Lord Bledisloe commissioned him to paint the replica, which has now been sent to New Zealand.

IN honor of the eighty eighth birthday on February 10 of Hofrat Dr. Gustav Riehl, emeritus professor of dermatology at the University of Vienna, the issues of the *Wiener klinische Wochenschrift* of February 8 and of the *Wiener medizinische Wochenschrift* of February 9 were dedicated to him.

THE annual award of the Pittsburgh Section of The American Chemical Society was on February 17 presented to Charles Edward Nesbit, chief chemist of the Edgar Thompson Steel Works and for many years the treasurer of the Pittsburgh Section. The title of the accompanying paper by Mr. Nesbit was "The Disintegration of Fire Brick Linings in the Iron Blast Furnace."

THE Joseph A. Capps Prize for 1934 of the Institute of Medicine of Chicago has been awarded to Lars F. Gulbrandsen, instructor in bacteriology and public health at the University of Illinois College of Medicine, for his paper on "Invasion of the Body Tissues by Orally Ingested Bacteria and the Defensive Mechanism of the Gastro Intestinal Tract." The prize of $500, established by an anonymous donor in honor of Dr. Joseph A. Capps, is awarded annually for the most meritorious medical research by a graduate of a medical school in Chicago completed within two years after graduation.

THE Osborne Reynolds Medal for meritorious contributions to the progress of the British Institution of Chemical Engineers has been awarded to H. J. Pooley, general secretary of the Society of Chemical Industry.

ROBERT J. MOORE, of the Bakelite Corporation, was reelected chairman for 1935–36 of the American Section of the Society of Chemical Industry at the meeting of the society held in New York City on March 8. Other officers elected for the ensuing year are: W. D. Turner, Columbia University, *vice chairman*; Foster Dee Snell, Foster Dee Snell Incorporated, *secretary*; J. W. H. Randall, consultant, *treasurer*. New members of the executive committee are: Wm. H. Gesell, Lehn and Fink Incorporated; Elmer K. Bolton, E. I. du Pont de Nemours and Company; J. B. Rather, Socony Vacuum Corporation; E. R. Weidlein, the Mellon Institute.

DR. JOHN F. BOVARD, dean and director of physical education at the University of Oregon and Oregon State College, has been elected president of the Northwest District of the American Physical Education Association.

DR. PETER O. OKKELBERG, professor of zoology in the University of Michigan, has been appointed to the newly created post of assistant dean of the graduate school. He will continue as secretary of the school, a position that he has filled during the past five years.

DR. RUDOLPH E. LANGER, professor of mathematics at the University of Wisconsin, has been appointed lecturer on mathematics and tutor in the division of mathematics at Harvard University.

DR. WILLIAM ORR SWAN, professor of chemistry at Southwestern, Memphis, Tenn., has been appointed head of the department of chemistry at the Virginia Military Institute. He succeeds Colonel Hunter Pendleton, who has served for the past forty five years.

DR. I. R. POUNDER, assistant professor of mathematics at the University of Toronto, and Dr. A. H. S. Gillson, associate professor of mathematics at McGill University, have been promoted to full professorships.

DR. FREDERICK SEITZ of Princeton University, has been appointed instructor in physics at the University

of Rochester, where he will have charge of the work in theoretical physics

THE *Journal* of the American Medical Association reports that following the resignation of Kiheiji Onodera, president of the Tokyo Imperial University, the fifth presidential election took place on December 15 Professor Dr Mataro Nagayo, dean of the medical department of the university, was elected the next president by the majority of 98 out of 164 votes He was born in 1878 and had been director of the Infectious Disease Research Laboratory from 1919 to 1933 He was also president of the Cancer Research Institute His present post of dean will be taken over by Professor Dr Hisomi Nagai, professor of physiology in the university

DR NATHANIEL WALES FAXON since 1922 director of the Strong Memorial Hospital of the University of Rochester, has been appointed director of the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary, Boston Dr Faxon, who graduated from Harvard Medical School in 1905, was assistant director of the Massachusetts General Hospital from 1919 to 1922 He succeeds Dr George H Bigelow, who has been missing since December, 1934

DR ARTHUR D LITTLE, who has retired as president of Arthur D Little, Inc, has been elected chairman of the board Dr Little becomes chairman within a year of the fiftieth anniversary of the organization His staff now includes graduates of twenty two universities and technical schools

SIR GEORGE NEWMAN will retire on March 31 from the posts of chief medical officer of the British Ministry of Health and of the Board of Education, and will be succeeded by Dr A Salusbury MacNalty, who, in turn, will be succeeded by Dr Thomas Carnwath as deputy to the chief medical officer

THE position of assistant entomologist at the Rothamsted Experimental Station, England, made vacant by the appointment of H C F Newton as advisory entomologist to the West Midland Province, at the Harper Adams Agricultural College, Newport, has been filled by A Coulston Evans, assistant plant pathologist at the Long Ashton Research Station of the University of Bristol

THE Committee on Scientific Research of the American Medical Association has made a grant of $200 to Professor Israel S Kleiner, of the New York Homeopathic Medical College and Flower Hospital, for work on the analysis of various materials for ascorbic acid (Vitamin C) The research work will be actively conducted by Dr Henry Tauber

THE Executive Committee of the Federation of American Societies for Experimental Biology announces the following awards of fellowships for attendance at the fifteenth International Physiological Congress, which will be held in Leningrad and Moscow next August In physiology, Dr J M Wolfe, Vanderbilt University, on biochemistry Dr Abraham White, Yale University, on pharmacology, Dr Bernard M Jacobson, Harvard Medical School, and in pathology, Dr William Mahoney Yale University

DR. F GREGORY HALL professor of zoology at Duke University, has received a grant from the National Research Council to permit him to join an expedition that will leave in April for the Andes in northern Chile to study the physiological effects of extremely high altitudes on men and animals

DR NORBERT WIENER, professor of mathematics at the Massachusetts Institute of Technology, has been granted a leave of absence for the next academic year to join the faculty at the National Tsing Hua University at Peking, China

DR ARNOLD A ZIMMERMANN, assistant professor of anatomy at the University of Illinois College of Medicine, Chicago, will continue his studies on the lymphatics of the opossum in the laboratories of the Wistar Institute of Anatomy, Philadelphia

DR JAMES JESSE TURNER professor of biology at Hiram College, Ohio has returned to the college after conducting an ecological study of the flora of the southeastern states, including the coastal plain and the swamps of Florida

DR HANS ZINSSER, of the Harvard Medical School, was the principal speaker at the annual dinner of the Columbia Alumni Club of Paris on February 12 Dr Zinsser spoke of his work and in particular of the effect of disease on the political and military history of the world

DR DAVID P BARR, professor of internal medicine in the School of Medicine of Washington University at St Louis, recently returned from a trip to Australia, where he delivered a series of lectures at the special invitation of the Melbourne Permanent Post Graduate Association This association conducts for the benefit of the physicians of the state of Victoria more or less continuous post graduate instruction During the past decade it has been their custom to invite each second year a physician or surgeon either from England or from the United States to assist in this instruction and to give a series of stated lectures

AT a meeting of the Electrochemical Society, held this week in New York City, Professor W W Stender, of the University of Leningrad, reported upon the new alkali-chlorine industry of Russia

Dr. C A Edwards, principal of University College Swansea, Wales, gave a lecture at the museum of the Franklin Institute, Philadelphia, on March 8, entitled 'A Consideration of the Internal Atomic Disturbances that Occur during the Straining of Metallic Crystals"

Bartram Thomas, the English explorer and orientalist, lectured on his first crossing of the Great Southern Desert of Arabia before the University of Virginia on March 4

Professor Joseph Needham, who is Sir William Dunne reader in biochemistry at the University of Cambridge gave during March a series of three Terry lectures at Yale University He spoke on the general topic of 'Order and Life" The Terry lectures have been given in previous years by John Dewey, Robert A Millikan, Arthur H Compton, William E Hocking and Henry Norris Russell

The fourth lecture in the Smith Reed Russell series at the School of Medicine of the George Washington University was given before the faculty and students on March 5 by Dr E V McCollum, professor of biochemistry of the Johns Hopkins Medical School Dr McCollum's subject was The Rôle of the Vitamins in Relation to the Bodily Resistance to the Infectious Diseases"

Professor Harold C Urey, of Columbia University, gave a lecture on Monday, March 18, at the University of Rochester before a joint meeting of the Rochester Sections of the American Chemical Society and the Optical Society of America His subject was "Isotopic Equilibria and Separation of Isotopes" Future meetings of the Rochester Section of the Optical Society are as follows April 9, Dr W E Forsythe, Cleveland, Ohio, Light Sources for Photographic Purposes', April 23, Professor Brian O'Brien, University of Rochester, 'The National Geographic United States Army Air Corps Stratosphere Flight", May 14, Dr Lyman J Briggs, director, National Bureau of Standards, 'The Work of the National Bureau of Standards"

The New York Branch of the American Psychological Association will hold its sixth spring meeting at Princeton University, on Saturday, April 13, beginning at 9 o'clock There will be sessions on comparative psychology, child and differential psychology, physiological psychology, experimental psychology and social and abnormal psychology, and an address by the honorary president, Dr Joseph Jastrow

The one hundred and ninety-eighth regular meeting of the American Physical Society will be held in Washington, D C, on April 25, 26 and 27 The Thursday and Friday sessions will be held at the Bureau of Standards and the Saturday sessions at the National Academy building Other meetings during 1935 are as follows June 21–22, Minneapolis, June 24–28, Los Angeles, November 29–30, Baltimore, December, the Pacific Coast, annual meeting, St Louis, Mo

The first annual meeting of the American Institute of Tropical Medicine will open in New York City on Tuesday, April 16

The International Congress of Neurology will be held in London from July 29 to August 2

Dates for the ninth season of the Allegany School of Natural History in Allegany State Park, New York, conducted by the Buffalo Society of Natural Sciences in cooperation with the New York State Museum and affiliated with the University of Buffalo, have been set for July 5 to August 24, 1935 Dr Robert F Coker, of Chapel Hill, N C, is director of the school The following courses will be given in field botany by Dr Robert B Gordon, of the Ohio State University, in field geology by Gordon I Atwater, of the University of Iowa, in the natural history of birds by Aretas A Saunders, of the Central High School Bridgeport, Conn, in nature study, by Professor William P Alexander, of the Buffalo Museum of Science, in field zoology by Dr Robert E Coker The administrative staff will include Mrs Robert E Coker, dean of women, Esther W Eno and Oscar M Waddell, of the Buffalo Museum of Science, secretary and camp manager, respectively

Nature reports a bequest from Lady Dewar, who died on January 7, of ten thousand pounds to the Royal Institution The gift is free of duty, and is made on the condition that the income is to be used for the purpose of furthering scientific research in the institution and as a permanent memorial to the work there of her husband, Sir James Dewar, who succeeded Tyndall as superintendent of the institution in 1887 Lady Dewar has also left to the institution Sir James's medals and diplomas and his scientific papers and apparatus, together with a sum of money to provide accommodation for them A large part of his apparatus, in particular that used in his low temperature researches, has remained at Albemarle Street since his death, and in recent years has been displayed in the institution's collection The papers and objects now presented are additional material likely to be of historic value in relation to the period of Dewar's professorship Lady Dewar's other bequests include £4,000 to the Royal Society's Mond Laboratory at Cambridge and £3,000 to the Royal Academy of Music. The residue of the estate is left for the furtherance of research in chemistry and physics at one of the Universities of Edinburgh, St Andrews, Glasgow or

Aberdeen, or for the assistance of bacteriological research in connection with the Royal Infirmary of Edinburgh and the Glasgow Royal Infirmary

IN recognition of the bequest of his valuable library of some 5,000 volumes to the Field Museum of Natural History, the late Dr Berthold Laufer, formerly curator of anthropology at the museum, has been posthumously honored by election as a contributor of the institution Contributors form a special class of membership designating those whose gifts in money or materials range in value from $1,000 to $100,000

Two new fellowships for graduate students in botany and chemistry for the coming year at the University of Oklahoma have been announced by Dr Homer I Dodge, dean of the graduate school The Ray M Balyeat fellowship offering a $600 stipend for study in any school, will be given to encourage students to study chemical substances concerned with allergy A fellowship and stipend, not yet determined, to encourage the study of wild plants of Oklahoma and their possibility as ornamentals is being offered by Oklahoma garden clubs

A NEW quarantine prohibiting movement of elm trees out of regulated areas in New York, New Jersey and Connecticut, because of the spread of the Dutch elm disease, took effect on February 25 The quarantine applies to all plants or parts of plants of all species of elms, whether grown in nurseries, forests or on private property The campaign is under the direction of L H Worthley, of the Bureau of Entomology and Plant Quarantine U S Department of Agriculture, with headquarters at White Plains New York

DISCUSSION

BALANCED DIETS, NET ENERGY VALUES AND SPECIFIC DYNAMIC EFFECTS

IN a recent number of SCIENCE[1] H H Mitchell presents a theoretical discussion of the subject of this communication, involving certain of the writer's published conclusions

After developing a line of argument similar to and in harmony with that of the writer in the publication of the so designated 'law of maximum, normal nutritive value," Mitchell discusses the significance of this principle in relation to net energy values, saying, in part

> With these definitions in mind, the first implication of the above defined conception of nutritive balance in a ration or diet is that except for differences in digestibility, the net energy of all perfectly balanced rations is the same under the same conditions of feeding, or somewhat more precisely, the net availability of the metabolizable energy of all perfectly balanced rations is maximal for any imposed conditions of feeding

Further, he says

> However, Forbes' recently announced 'law of maximum, normal nutritive value,'' although it advocates the use of completely balanced rations in determinations of net energy values, does not state nor imply that the net availability of the metabolizable energy of such rations will be maximal and identical

It is true that, in my "law of maximum, normal nutritive value"[2] I avoided making any statement or implication to the effect that the net availability of the metabolizable energy of completely balanced rations is maximal and identical (though we had discussed the idea), because I can not conceive of balanced rations—as practicable entities—being so perfectly balanced that there would be no individuality of dynamic effect of the nutrients serving the same purposes in different rations, and that there would be no differences in either the excess nutrients, or in substances present without nutritive value which would affect the economy of utilization of metabolizable energy

One must remember, in theorizing that in feeding practice we deal not with pure nutrients of known identity and character but—in each feeding stuff—with a vast complication of little known substances

Also, it is only fair to call attention to Mitchell's misstatement to the effect that my law of maximum, normal nutritive value advocates the use of completely balanced rations in the determination of net energy values" In publishing this principle I did not mention "completely balanced rations,' but did use the expression 'a ration which is qualitatively complete and quantitatively sufficient —which has a distinctly different meaning in that the idea of a complete diet provides only for the presence of all required nutrients, in the necessary quantities while the perfectly balanced ration—literally—must not only be complete, but must not contain an excess of any nutrient It is true, however, that, at an earlier date, I had—less carefully—used the expression "completely balanced rations' in a similar discussion[3]

Proceeding further, Mitchell calls attention to my statement that "an individual foodstuff expresses its normal and most characteristic nutritive value—only as it is a part of a ration which is qualitatively com

[1] SCIENCE, 80 558–561
[2] SCIENCE, 77: 306–307

[3] *Proc Amer Soc Animal Production, Ann Meeting*, 1932 32–40

plete and quantitatively sufficient ..." The question which Mitchell raises is, in reality, "which is the 'normal and most characteristic value' of a foodstuff—that determined by its full potentialities, when it is adequately supplemented, or by its limitations, when fed alone?" The difference is simply one of point of view. It is normal to use feeding stuffs as components of approximately complete rations; they are not commonly fed alone, and I have used the word "characteristic" to mean "representative."

Mitchell states that "the recent developments in the net energy conception, initiated and defended by the Pennsylvania group, have tended to complicate the problem of net energy determinations and perhaps even to discourage those who have hoped to put the conception to practical use in the rationing of farm animals."

There have been no recent developments in the net energy conception, so far as I know. It remains as at first proposed, and it is as unassailable as the law of conservation of energy. But there has been much new light cast upon the subject of energy metabolism, and a searching analysis of the problem of determining energy values in studies published from this institute—which, however, should be discouraging only to those who adhere to the objective of determining net energy values *of individual feeding stuffs as constants*.

The idea of determining net energy values of rations, however, is worthy of consideration. This is a logical deduction from the work of this institute. I have made this deduction, have advocated the determination of such values, and have enumerated some of their apparent uses in the study of problems in the field of animal production.[3]

In regard to Mitchell's speculations as to the cause of specific dynamic action, the relation of the dynamic effects of nutrients to the combinations in which they are fed, etc., we do not care to comment, especially since the methods of determination of specific dynamic effects, and the measurements of these effects—in the literature—have been so unsatisfactory, in fact, so largely fallacious, in the light of findings of this institute during the past six years, especially as set forth in a very recent paper by Kriss, Forbes and Miller,[4] which places the problem of determining specific dynamic effects of nutrients in a new and vastly improved position.

The new point of view and procedure depend upon Rubner's idea[5] of a specific dynamic effect of body substance katabolized, from which follows the hypothesis (Forbes, Braman and Kriss,[6]) of a status of minimum heat production of life in which the energy requirement of the animal would be rendered available without waste of heat—that is, without energy expense of utilization, heat increments (dynamic effects) as usually determined at planes of nutrition below energy equilibrium being less than the true energy expense of utilization by the amount of the dynamic effect of body nutrients katabolized (Forbes, Braman and Kriss[7]), heat increments determined above maintenance, with the heat production of maintenance as the base value, therefore representing the true energy expense of nutrient utilization.

We are free to admit, however, that if—as we have concluded—net energy values of individual foodstuffs are not constants, because of the supplementing effects of food combination, in rations, and other conditions affecting the economy of food utilization, then it is conceivable that, for similar reasons, specific dynamic effects of individual nutrients likewise are not constants. We have unpublished results on conditions affecting specific dynamic action, and a second year's experiments on the subject are in progress.

The recent studies of this institute on specific dynamic effects and their determination afford an improved basis of understanding and procedure from which to investigate this question. In this connection I would propose that it would save confusion to limit the term "specific dynamic effect" to signify the dynamic effect of specific kinds of nutriment, and to use the equivalent term "heat increment" to signify other dynamic effects—that is, those which are not specific of particular kinds of nutriment.

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[3] Jour. Agr. Research, 40: 77, 1930.

[4] Jour. Nutrition, 8: 509–534.

[5] "Die Gesetze des Energieverbrauchs bei der Ernährung," Leipzig und Wien, 1902, S. 370.

[6] Jour. Agr. Research, 37: 285, 1928.

[7] Jour. Agr. Research, 40: 77, 1930.

MORE EVIDENCE ON THE STRUCTURE OF CHROMATOPHORES

A RECENT communication by Herrick[1] regarding the discussion between Sumner and Mast as to the nature of the chromatophore leads me to enter the lists. Like Herrick, I am not concerned with the problem of terminology; I disagree with Herrick, however, on several points of structure and function. The evidence I wish to present in brief, below, is from two types of chromatophore differing from each other and from Herrick's material. Herrick used epidermal melanophore of frog tadpole; my observations were on melanophore of goldfish and chromatophore of squid.

First, Herrick comments that he has "seen no evidence to support the statement of Mast[2] that pigment granules move on definite paths through the cytoplasm." In melanophores of goldfish with Chambers'

[1] SCIENCE, March 16, 1934.

[2] SCIENCE, November 10, 1933.

micromanipulator,[3] I have been able to push the pigment granules entirely out of place, they slip back into the same position, however, when the needle is removed Nor is this the result of purely mechanical pressure—it can be seen in living untouched cells, though less strikingly Likewise, when the pigment granules are so pushed out of place I have been able to see definite intracellular channels, evidenced by differences in the organization of the cytoplasm, in the place where the granules have been

In the next place, I have observed that, untouched, the rate of movement of these granules varies as the distance from the central pigment mass Under stimulation with the needle, the rate is definitely correlated with the distance from the point of application of the needle and the state of aggregation of the parent granule mass I have seen no jerkiness or variableness in rate of movement that could not be explained as necessitated by the position of the granule in the stream Nor did I ever see one granule lingering and then overtaking others

On the other hand, however, living squid chromatophores in tissue cultures[4] will often pulsate without changes in the position of the pigment, which may at such a time be highly diffused in clumps, or scattered, leaving absolutely clear and entirely homogeneous unchannelled spaces in the chromatophore At other times when the chromatophore pulsates, the pigment occupies not nearly the whole area of the visible sac like chromatophore In this material, then, there is no evidence of definite paths in the cytoplasm nor of regular rate of movement of the granules

To my mind this situation proves to be just another of those cases in which we tend to attempt to bring under one head a number of phenomena which have similar appearance but entirely different structural or functional nature The work of Parker and his students, and others, seems to indicate that this is true of the control of the chromatophores my impression is that investigators may well agree that it is also the case as regards their nature and activity

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IS THERE A DIGESTIVE CANAL IN CILIATES?

COSMOVICI[1] recently reported seeing a coiled canal running from the cytostome to the cytopyge in *Colpidium colpoda* Hall and Alvey[2] failed to confirm this observation Recently I noticed a peculiar thing which tends to confirm Cosmovici's results

While feeding carmine to Protozoa I saw an individual of *C striatum* which had long strings of carmine in its cytoplasm The appearance could easily have been caused by the animal's having taken carmine into a digestive canal, such as that described by Cosmovici This individual entirely lacked typical food vacuoles, although others in the preparation were forming them readily Another specimen from the same culture possessed both carmine strings and food vacuoles These two were the only individuals seen to have these carmine strings, despite repeated attempts to find others

Hall and Alvey criticize Cosmovici's interpretation of his results by pointing out that the canal seen by the latter may well have resulted from the conditions of his experiments and thus not be a normal structure This is in accord with my own view, I can not yet believe that a digestive canal occurs in normal Protozoa Nevertheless, the limited observations reported here could not easily be explained by the same type of criticism It would appear, therefore, that the question of a digestive canal in Protozoa is not yet settled

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THE BLUE LIGHT IN THE SEA

IN SCIENCE of November 30 1934 Dr Beebe wrote a preliminary statement of the results of his descents into the sea in the bathysphere during the summer of 1934 In the course of his investigations of the undersea illumination he made the following interesting observations

> The day of the first dive was an exceedingly brilliant one and the surface of the sea very calm In consequence, light was still visible to the eye at 1900 feet, 200 feet farther than on any previous dive to this depth At 2000 feet not the slightest hint of illumination was observable
>
> A problem of color not yet explained is that from 200 feet down, through the spectroscope, the blue is gradually replaced by violet, until at a depth of 400 feet the latter color is dominant Yet to the eye, at no time of the descent is there any trace of violet or lavender, only the strongest of blues, appearing brilliant long after it has lost all power for actually seeing anything in the bathysphere

It seems that the blue fluorescence of the eye when subjected to ultra violet and violet light may be the explanation of the fact that to Beebe the light appeared a blue color, whereas in the spectroscope only violet light was seen Professor R W Wood in public lectures some years ago demonstrated in a very striking manner the "violet haze," as he called it, which was seen by the eye stimulated with ultra violet

[3] Reported before the Louisiana Academy of Sciences, Shreveport, La, March, 1932

[4] Reported before the Louisiana Academy of Sciences, Ruston, La, March, 1933

[1] C R Soc Biol, Vol 106, pp 745–749, 1931

[2] Trans Am Micros Soc, Vol 52, pp 26–32, 1933

light In his experiments he used a mercury arc surrounded with black glass, which transmitted mainly the 366 lines of mercury When this radiation fell into the eye it caused fluorescence of the materials of the eye, with the result that the observer saw a violet haze, which, being in the eye, was not useful for seeing anything The effect corresponds exactly with the last sentence above quoted from Beebe

The color of the eye fluorescence is somewhat uncertain Wood spoke of it as a 'violet" haze W de Groot[1] arranged an experiment in which various people looked at ultra violet lines, and presented the results thus "For 3650, 3345 and 3261 the description which the persons gave of the color was remarkable They described it as a clear blue whereas the Hg line 4047 and Zn line 4057 were described as violet It seemed to them as if the succession in the spectrum was reversed To myself the color appeared more greyish, although with a hue distinctly bluer than that of the recognized 'violet lines"

It must be remembered that Dr Beebe was observing the phenomenon on a grander scale than has been produced in the laboratory The entire scene which he saw through the quartz window of the bathysphere was lighted with the shorter wave lengths of the daylight spectrum

To work out the effects quantitatively will require more exact data than are available at present on the absorption coefficients of sea water for visible and near ultra violet light and on the visibility curve of the eye extended into the ultra violet region of the spectrum

On the basis of the foregoing explanation one is led to wonder about the fluorescence of the eyes of fish The fluorescence would be troublesome for undersea daylight vision at these depths, and its absence from the eyes of creatures in such an environment would appear to be a favorable adaptation

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[1] *Nature*, September 29, 1934

UNUSUAL SKY APPEARANCE

A CORRESPONDENT from Vienna Va, writes that on either January 22 or 23, about 8 o'clock in the evening, she saw a light flashing in the southwest something like lightning It would flare up several times, then die down As she watched it, it became very vivid till it seemed to come from a great blazing light, almost a ball of fire All this time it was moving around the horizon from the southwest until it had almost reached the starting point She thought it perhaps more vivid when in the north, and that it seemed to be dying away in the southeast It appeared to be very low, just showing above the foothills

I myself was driving along Wisconsin Avenue in Washington on the evening in question, with my wife, and we were startled by what was probably the same appearance It resembled what is called "heat lightning," only that it seemed to be very near indeed and not associated with any noise The night, as I recall it, was very cold and dry, and I believe on the turn between two contrasting types of weather

I would appreciate it if any of your readers will suggest to me an explanation

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BOOKS AND LITERATURE

THE MICROPHYSIOLOGY OF NERVE

The Microphysiology of Nerve By GENICHI KATO 139 pp, 1934 The Maruzen Company, Ltd, Tokyo, Japan

IN this concisely written monograph, Professor Kato has presented the results of a series of experiments utilizing his technique for isolating single nerve or muscle fibers in the Japanese toad Using preparations in which either a single nerve or muscle fiber or both have been dissected free, Kato and his co workers have abundantly demonstrated that the nerve impulse completely recovers after passing through a narcotized region The magnitude of the conducted response of a single muscle fiber stimulated through a single nerve fiber is always the same at any strength of stimulus above threshold Graded, non conducted muscle fiber contractions localized at the site of small stimulating electrodes are obtainable only with weak stimuli and are unaccompanied by action potentials Kato compares these responses to peculiar localized contractions occurring as a result of stimulation of a completely narcotized region of a muscle Both of these types of contraction are found only under restricted conditions as a result of artificial stimuli and are entirely different from the conducted contractions in which there is no deviation from the all-or none principle

In observing spinal reflexes, Kato has shown that ipsilateral afferent stimuli are inhibitory to a crossed extensor reflex (frog) at certain moderate current strengths, while with greatly increased strength of stimulation of the same nerve trunk the effect is summation with the crossed stimulation This summation is a function of fibers which originate from free nerve endings in the epidermis, whereas the inhibitory effects

result from stimulation of nerves arising in muscles He suggests that there are two types of afferent nerve fibers (a) inhibitory fibers, easily narcotized and having a low threshold of stimulation and (b) excitatory fibers which are less susceptible to narcotization and have a high threshold Kato has isolated these two types of fibers and has demonstrated that the central effect of the inhibitory fibers, which are about 9 5μ in diameter, is only inhibition with stimuli of any strength or frequency even after the application of strychnine Stimulation of the excitatory afferent fibers, whose diameter is 6 to 7μ, results only in summation with crossed excitation Kato has also localized an inhibitory center at the level of the *lamina terminalis* from which fibers are projected into the cord decussating slightly caudal to the crossing of the motor tract

Kato does not offer experiments that would refute the view, now generally prevalent, that the nerve impulses which give rise to inhibition do not differ fundamentally from those whose central effect is excitatory Evidence is accumulating from many sources tending to show that not only are impulses in nerve fibers non specific but also in intra central terminals as well Therefore, whether a discharge into the cord gives rise to excitation or inhibition depends upon the nature of the reactions set up at the particular point on the neurone at which the discharging nerve terminal forms a synapse The significance of Kato s experiments lies in the fact that they lend support to the hypothesis that a particular synapse when discharged by its nerve fiber always produces the same non reversible effect, one synapse when activated always develops excitatory state, and another always inhibitory state However, a single afferent fiber may end not only in nerve terminals (boutons terminaux) which contribute to the development of an excitatory state in one neurone, but it may also send collateral branches to another nerve cell or cells on the same side of the cord, which end in boutons whose discharge results in inhibition

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THE GRASSES OF THE UNITED STATES

Manual of the Grasses of the United States By A S HITCHCOCK U S Dept Agr Miscel Publ 200 1–1044 figs 1–1696 1935 Superintendent of Documents, Government Printing Office, Washington, D C, $1 75

No family of plants is of such outstandingly great importance to man as is the grass family, including as it does all our cultivated cereals, the basic foods of the majority of mankind, most of the wild and cultivated species on which the grazing and dairy industries are based, and numerous species otherwise of great economic importance It is thus fitting that the first comprehensive treatment of the entire family, as represented in the continental United States, should appear under government auspices It is a botanical contribution of first magnitude and one of great economic and scientific moment In the introductory pages the uses, distribution, morphology, classification and nomenclature of grasses are considered, followed by a key to the tribes and genera, while under each genus is a key to the species There are 159 numbered genera and 1,100 numbered species, with additional data appertaining to casually introduced and cultivated forms Each species is illustrated, while the accompanying maps graphically indicate the geographic distribution in each case The descriptive text is not encumbered with synonyms, but for those who must consider synonymy, a full list of synonyms, by accepted species in alphabetic sequence is given at the end of the work, pages 771–982 Here and there in the synonymy critical notes are given and for all originally published species, as contrasted to transfers, the type locality is indicated How complex synonymy has become may be evidenced from the fact that for a number of species more than 20 synonyms are listed, and for at least one species more than 70 synonyms are given This list of synonyms provides the basis of selection of the accepted name in each case, the nomenclature following the International Rules The compilation of this list, a major task, shows evidence of most careful and critical bibliographic and herbarium work, and there seems little chance that few if any earlier names will be detected by future workers that would replace those accepted in this important work

The work is planned to meet the needs of the botanist, the agronomist, the forester and the agriculturist hence the inclusion of supplementary economic notes under the various genera Common names of cultivated species follow 'Standardized Plant Names," while those for native and naturalized species have apparently been arbitrarily selected, as were many of those in that work, for these the author is not responsible (p 14) Thus under *Muhlenbergia* one notes the most unusual and apparently new common name "muhly," while fox tail, which is widely used for *Setaria*, is replaced by bristle grass and the name for fox tail is associated with *Alopecurus* These arbitrary changes can not conceivably effect accepted usage, and unquestionably it would have been better to apply common names, as does the man on the land, rather than to have invoked arbitrary selection

This is a major contribution to our knowledge of the grasses of North America, marks the culmination of more than thirty years of intensive work on the part of the author, and will be found to be of great

value not only to botanists in diverse fields, but to a great number of individuals interested in various phases of agriculture, forestry, conservation soil erosion, irrigation and other fields Fortunately for those who need and must have this work, it is a public document and is so priced as to be available to all

E D MERRILL

NEW YORK BOTANICAL GARDEN

SOCIETIES AND MEETINGS

THE INDIANA ACADEMY OF SCIENCE

THE golden anniversary meeting of the Indiana Academy of Science was held on Thursday, Friday and Saturday, November 15, 16 and 17 at Indianapolis, with the academy as the guest of Butler University The general meetings were devoted to its history and the honoring of its living founders At the sectional meetings a total of ninety-eight papers on botany, chemistry bacteriology, geology, geography, physics, mathematics and zoology were read The meetings were all well attended

The principal address of the historical meeting was given by Dr Will E Edington, of DePauw University on the subject, There Were Giants in Those Days" The address dealt with the various factors that led up to the founding of the academy in 1885, and was illustrated with slides showing the principal founders Among these were David Starr Jordan, T C Mendenhall John M Coulter John C Branner, Daniel Kirkwood John Sterling Kingsley Thomas Gray Oliver P Jenkins, Richard Owen Alexander Smith Harvey W Wiley Joseph Swain William A Noyes Amos W Butler, Barton W Evermann Lillien J Martin, Carl H Eigenmann Willis S Blatchley, Joseph C Arthur Stanley Coulter and others Following this address ten of the fifteen living founders who were present were introduced to the assembled members of the academy

The president's address was delivered by Father Julius A Nieuwland, of the University of Notre Dame on The Story of Synthetic Rubber which was a report on the work for which he has been awarded the Nichols Medal by the American Chemical Society

The Founders' Dinner was held on the evening of November 16 at the Claypool Hotel with several hundred members in attendance Following the dinner, the ten living founders who were present gave short talks These founders are J C Arthur, George W Benton, W S Blatchley, J B Burris, Amos W Butler, Stanley Coulter, Robert Hessler, David M Mottier, William A Noyes and A J Phinney They were presented with certificates of appreciation for their service to science and to the academy, John S Wright, of the Eli Lilly Company, acting as master of this ceremony

Several scientific men from without the state were present Of these particular mention may be made of Dr Henry B Ward, permanent secretary of the American Association for the Advancement of Science Dr Ward attended the meetings of the executive committee and made a short address at the founders' dinner in which he discussed the meeting of the association to be held in Indianapolis in 1937

The Junior Academy, composed of a number of high school science clubs, held its meetings on Saturday morning These included scientific exhibits

There were on display a number of scientific exhibits and also an exhibit of photographs of all the past presidents of the academy and a majority of the founders It is the intention of the academy to file these photographs slides made from them and other historical material in the State Library so that it will be accessible for use in lectures and other work At the request of Dr Ward photographs of all the past presidents are to be exhibited at the St Louis meeting of the American Association for the Advancement of Science

The following officers were chosen for 1935 *President* Will Scott Indiana University, *Vice President*, Will E Edington, DePauw University, *Secretary*, Ray C Friesner, Butler University *Treasurer*, William P Morgan Indiana Central College, *Editor of the Proceedings* Paul Weatherwax, Indiana University *Press Secretary* Thomas R Johnston Purdue University The next winter meeting will be held at Crawfordsville, Indiana with Wabash College as host

WILL E EDINGTON

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE NICOTINE VAPORIZER A DEVICE FOR UTILIZING NICOTINE IN THE CONTROL OF INSECT PESTS

FOR many years nicotine has been available in commerce in the form of nicotine sulfate having a content of 40 per cent nicotine alkaloid In the control of insect pests attacking vegetation under outdoor conditions, this material has been utilized in two ways, as an aqueous spray solution and as a dust mixture The insecticidal action appears to be due very largely

to the volatilization of the nicotine. In order to produce a more rapid liberation of the nicotine, various "activator" substances, such as hydrated lime, lime sulfur, an ammonium sulfate, have been added to the spray and dust. Attempts have also been made to increase the effectiveness of nicotine dust by discharging into the blast of dust the exhaust of the gasoline engine operating the blower, the slightly higher temperature tending to liberate the absorbed nicotine and produce a greater degree of volatilization.

Various insects attacking plants in greenhouses have been controlled by the vapor of nicotine produced by burning tobacco stems or a material on which nicotine has been placed, and by placing nicotine on a heated object.

The new device, which we have designated a nicotine vaporizer, has been designed with the object of effecting the control of insect pests of orchard, garden and field crops by means of nicotine sulfate or any form of nicotine concentrate applied as a vapor produced by heat or as a vapor like mist produced by atomization. The essential features of the device provide for atomizing the nicotine, conveying the mist through a heated chamber where it is vaporized with the formation of dense fumes, and thence conveying the vapor through a blower to the vegetation, or the finely atomized nicotine may be conveyed through the blower to the vegetation without being vaporized.

The machine which we have built and tested operates in the manner described as follows: The nicotine is contained in two chambers connected through a pressure regulator to a compressed air tank. Tubes arranged to produce atomization lead from the chambers and discharge into two copper pipes 2 inches in diameter and 30 inches in length. The pipes are inclosed in a shield to conserve heat. They are heated to a temperature of approximately 350° C. by a gas burner, utilizing compressed gas, extending lengthwise below them. The pipes extend into the intake of the blower of a standard type of duster used in insect control work. The blast of air from the blower carries the nicotine vapor or the atomized nicotine to the vegetation. The rate with which the nicotine is fed through the atomizer is governed by the pressure regulator.

Tests made with the vaporizer in the control of the codling moth, *Carpocapsa pomonella* Linn., have indicated that nicotine applied as a vapor is far more potent as an insecticide than where applied in the usual form of a spray or a dust. It is a well known fact that nicotine has no appreciable effect on the codling moth where applied as a dust, or as a spray at the usual concentration of one pint of nicotine sulfate to 100 gallons of water. An apple tree having a volume of approximately 4,000 cubic feet requires about 20 gallons of spray in order to effect a thorough coverage. With this quantity of spray the tree receives 90 cubic centimeters of nicotine sulfate. Tests have shown that 10 cubic centimeters of nicotine sulfate properly applied with the vaporizer will kill all the moths in a tree of this size.

The effectiveness of the treatment depends upon the concentration of the vapor in the atmosphere surrounding the insect and upon the length of time the insect is subjected to the vapor. The maximum degree of effectiveness is secured by discharging the vapor under a canvas cover dragged over the crop to be treated. For the treatment of orchard trees we have built and tested, with a fair degree of satisfaction, a device by means of which large trees may be inclosed and treated at the rate of one tree each half minute. This device consists of a transverse boom extending over two rows of trees, supporting a large canvas cover, adjustable for trees of different sizes, and provided with two curtains which permit inclosing the trees quickly and completely, all mounted on an automobile truck.

The development reported in this article owes its origin to a suggestion to try burning nicotine, made by the junior author, Mr. Persing, in connection with tests on fumigating with hydrocyanic acid to control the codling moth.

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PRODUCING BRAIN LESIONS IN RATS WITHOUT OPENING THE SKULL

HERETOFORE all localized brain lesions in experimental animals have been produced by opening the skull and introducing some destructive agent, usually a knife or a thermocautery. Using heat as the destroying agent, we have found it possible to shorten and simplify the older procedure considerably by applying the cautery point *extracranially*. If a knife is used, it is of course necessary to trepine the skull. Heat, however, will readily penetrate the unremoved bony shell sufficiently to coagulate the underlying tissues. This technique is especially feasible when the skull bones are thin, as in the rat.

On some occasions, there may be good reasons for the use of a cutting edge and hence for removal of a portion of the skull. Even when tissue is destroyed by heat, there may be occasions when the heat should

be applied directly Nevertheless, we are of the opinion that the current practice of trepining before thermocautery is a neurological tradition rather than an ideal procedure In a species with poorly marked cortical surfaces, it can not be of much aid to have the surface in view at the moment of operation The maps of lesions presented by current investigators do not indicate that the prevailing techniques consistently produce the desired destruction In consequence of this lack of control of cerebral lesions, the researcher produces lesions in many animals and selects for study the animals which happen to possess the sort of destruction which he wishes to study, disregarding the remainder

This general procedure must be followed to day, regardless of how the lesions are produced If a hot instrument is applied extracranially the production of lesions is an extremely easy process The rat is anesthetized, the skull exposed, the cautery applied (in our instance, for fifty seconds), the wound sewed and covered with collodion Aside from preliminary anesthetization, the entire operation can be performed in three minutes The skull is left intact Far from being a cruder method this method seems to us to provide as good or even better control of the lesion than does the more complicated technique

The technique has been entirely successful in meeting our needs We wished to destroy all or most of the striate area By examining the relation between the striate area and the skull markings, we determined where the cautery should be applied Experimentation upon rats other than the main experimental group showed what duration of exposure to the heat would most often produce the desired destruction Examination of sections, to be reported in detail later, show that the desired effect with respect to location, depth and shape of lesion was produced more often than reports of other investigators would lead one to expect from the employment of the traditional methods

Our lesions were in general round in shape, two millimeters in diameter and were limited to the cortex It seems likely, however, that one could devise cautery points which would produce lesions of almost any desired shape, and that these lesions could be produced at any point adjacent to the skull The depth of the lesion may be controlled by varying the duration of the application of the heat, or by varying the intensity of the heat It is even possible that almost complete decortication might be produced by applying a relatively small cautery point to many areas or by making a metal cap to fit the skull and then applying it when heated

In addition to simplicity, the technique has the advantage of completely avoiding exposure of the cranial contents to the danger of infection

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SPECIAL ARTICLES

A FILTERABLE VIRUS RECOVERED FROM WHITE MICE

DURING recent work with the viruses of equine encephalomyelitis and hog cholera an infective agent was obtained from white mice which was pathologically and serologically distinct from both viruses Its origin was not definitely known, but it seemed likely that the natural host of the agent was the mouse in spite of the fact that in our mouse colony no disease had been previously recognized In an experiment designed to trace the origin of the infectious agent, 60 five week-old, healthy looking mice from our colony were each given an intracerebral injection of a small amount of sterile bouillon Fifty one of these mice showed no evidence of illness during the three weeks that they were under observation Four died in from 3 to 13 days following the inoculation, and three were killed on from the sixth to the eighth day when they showed symptoms similar to those observed in the mice inoculated with the unknown agent On the sixth day two additional mice that showed photophobia but no other symptoms were killed From one of these mice no material was obtained for inoculation, but bacteriologically sterile suspensions of the brain of each of the other eight when injected into guinea pigs caused symptoms which could not be differentiated from those produced by the original material This experiment, together with others, suggests that the infectious agent is carried by apparently healthy mice in our colony and that symptoms may be brought out by the intracerebral injection of foreign protein

Among the mice from our colony only about 60 per cent develop symptoms after intracerebral injection of infectious material and only 40 per cent. die The incubation period is from 5 to 10 days The clinical symptoms are somnolence, photophobia, tremors of the legs, followed by tonic spasms of the muscles of the hind quarters, shown when the mouse is lifted by its tail Paralysis has not been observed One of 30 mice inoculated with infectious material by the intraperitoneal route developed symptoms, while

intravenous and intracutaneous inoculations into the footpads have been negative The agent has been demonstrated in the brain as well as in the viscera of mice that have succumbed to the infection Macroscopically the only changes noted are a nutmeg liver and slight enlargement of the spleen A preliminary microscopic examination shows a certain degree of infiltration of the meninges, ependyma, choroid plexus and perivascular lymph spaces with round cells In addition there is necrosis of some of the nerve cells in the cerebral cortex, cerebellum, brain stem and spinal cord In the last the anterior horn cells are predominantly involved In the cerebellum it is the Purkinje cells that are affected There may be some proliferation of the ependyma and of the glia cells of the gray matter

Guinea pigs have proved to be very susceptible as they develop symptoms following intracerebral, subcutaneous and intranasal inoculation The mortality has varied with different strains used but has been practically 100 per cent after intracerebral inoculation and from 80 to 90 per cent following subcutaneous injection The course of the disease is more chronic than in mice, there being a remittent type of fever with emaciation, somnolence, salivation and markedly labored breathing Death occurred in from 10 days to 3 weeks after inoculation One of eight guinea pigs in contact with an infected animal developed the disease At autopsy pneumonia of the virus type is often encountered In addition to the changes noted in the mouse brains, acidophilic intranuclear inclusions have been found in the round cells present in the meninges and choroid plexi The infectious agent has been demonstrated in the brain blood and suspensions of the diseased lungs Three guinea pigs have recovered from the disease and have resisted further injections In a limited number of experiments attempts to infect rabbits have been negative

Material known to be infectious has shown no organized forms when examined by the usual bacteriological procedures and no growth has occurred on a variety of media The disease has been produced by material passed through Berkefeld "N" and "W" filters that have held back *B prodigiosus* and also by material that has been in 50 per cent glycerol for at least one month From these facts we conclude that the agent is a filterable virus

The disease caused by this virus is definitely different from infectious ectromelia [1] The virus of spontaneous encephalitis of mice described by Theiler[2] produces a different clinical picture and is confined to the central nervous system, whereas the virus we have been working with is distributed generally The origin of the virus recovered by Armstrong[3] from a monkey inoculated with virus from a human case of encephalitis during the St Louis epidemic has not been definitely established It produces a clinical picture in mice which is strikingly like that described above, and the lesions in the central nervous system have much in common with those observed in our animals

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[1] J Marchal, *Jour Path and Bact* 33 713, 1930
[2] M Theiler, SCIENCE, 80 122, 1934
[3] C Armstrong with pathology by R D Lillie, *Publ Health Rep*, 49 1019, 1934

THE RELATION OF STREAM DOUBLE REFRACTION TO TOBACCO MOSAIC VIRUS

IN a previous publication[1] we reported that juice expressed from tomato tissues infected with tobacco mosaic virus contains a high concentration of M C S D R (material causing stream double refraction), whereas juice from healthy tissues contains a relatively slight concentration of material causing this phenomenon

The high concentration of M C S D R in mosaic plants is probably subject to one of the following three explanations (1) The M C S D R in mosaic plants may be the same material as that in healthy plants, but is in much higher concentration in mosaic plants (2) The stream double refraction exhibited by juice from mosaic plants may be caused by a high concentration of virus particles together with a very low concentration of the material which causes stream double refraction in healthy plants (3) Most of the M C S D R in mosaic plants may be composed of a product of the virus or of the diseased host not present in healthy plants

Previous work[2] has shown that Vinson's purification technique removes all the detectable M C S D R from juice of healthy plants but leaves a high concentration of M C S D R and virus in infective juice When different methods of juice extraction were used it was found[1] that the method which yielded the highest concentration of M C S D R from mosaic plants yielded the lowest concentration from healthy plants and the method yielding the highest concentration from healthy plants yielded the lowest from mosaic plants When juice from healthy plants has been stored at room temperature for from 12 to 24 hours it no longer exhibits stream double refraction, whereas juice from mosaic plants contains a concentration of M C S D R even slightly higher than freshly extracted

[1] W N Takahashi and T E Rawlins, "Application of Stream Double Refraction in Identification of Streak Diseases of Tomato" *Phytopath* In press
[2] W N Takahashi and T E Rawlins, SCIENCE, 77 284, 1933

juice. All the above results indicate that the M.C.S.D.R. in healthy plants and that in mosaic plants have different properties and suggest that they may be different substances. This evidence therefore favors the second or third explanations given in the preceding paragraph.

If most of the stream double refraction produced by juice from mosaic plants is due to tobacco mosaic virus particles one should find the concentration of virus and M.C.S.D.R. to be positively correlated. In order to gain evidence on this relation juice was extracted from tissues which differed greatly in virus content. Different organs of mosaic tobacco plants, leaves of different hosts and chlorotic and dark green tissues of mosaic tobacco leaves were used as virus sources.

The critical dilution, which is the minimum amount of dilution required to cause the disappearance of stream double refraction, was used as a measure of the concentration of M.C.S.D.R. in infective juice. The virus concentration was determined by a modification of the half leaf method of Samuel and Bald.[3]

Following are typical examples of the critical dilutions found for infective juice from various tissues: Tobacco leaves, 1: 768, tobacco roots, 1: 256; tobacco stems, 1: 96, tomato leaves, 1: 256, *Martynia louisiana* leaves, 1: 256; *Nicandra Physalodes* leaves, 1: 224, chlorotic tissues of mosaic tobacco leaves, 1: 2048, dark green tissues of mosaic tobacco leaves, 1: 256. When the virus concentration in each of the above critical dilutions was determined by the half leaf method all were found to be approximately the same (Differed by less than 12 per cent.) This work has been repeated a number of times with similar results. It is therefore evident that when samples of juice obtained from different sources and containing different concentrations of virus are diluted until the stream double refraction just disappears all the diluted samples contain approximately the same concentration of virus. The stream double refraction technique therefore provides a rapid and satisfactory method for determining virus concentration in fresh juice or that which has been preserved by freezing, the virus concentration the original undiluted sample being proportional to the dilution required to cause the disappearance of stream double refraction.

Heating mosaic juice to 100° C. for 10 minutes is known to inactivate tobacco mosaic virus and was also found to destroy the power of the M.C.S.D.R. to produce stream double refraction. A heavy precipitate was formed during the heating, and it is supposed that the M.C.S.D.R. was coagulated and was therefore unable to cause stream double refraction.

[3] G. Samuel and J. G. Bald, *Ann. Appl. Biol.*, 20: 70–99, 1933.

If the virus particles are not the colloidal particles causing most of the stream double refraction exhibited by juice from mosaic plants they may have a different size or a different isoelectric point and if so the virus should be separable from the M.C.S.D.R. by ultrafiltrations or electrophoresis. All experiments conducted have indicated that the M.C.S.D.R. in the mosaic plants behaves the same as the virus during ultrafiltration and electrophoresis and can not be separated from the virus by such treatments. All the above evidence has favored the hypothesis that the virus particles are responsible for most or all of the stream double refraction exhibited by juice from mosaic plants.

Two conditions were found in which virus concentration was not positively correlated with concentration of M.C.S.D.R. In certain samples of aged virus from mosaic tobacco plants the concentration of active virus was found to be much lower than that of M.C.S.D.R. and in virus treated with ultrasonic radiation the virus was completely inactivated after two hours,[4] whereas the concentration of M.C.S.D.R. remained high. These two experimental results are probably subject to one of two interpretations: (1) That the virus and M.C.S.D.R. are different, (2) that the virus particles inactivated by aging or ultrasonic radiation are not changed in external form sufficiently to prevent stream double refraction.

Although much of the evidence cited above favors the supposition that the virus particles are the causal agent of most of the stream double refraction exhibited by juice from mosaic plants the evidence remains inconclusive. However, since the concentrations of virus and M.C.S.D.R. in fresh juice or that preserved by freezing have always been found to be positively correlated the stream double refraction technique provides a rapid and reliable method for determining virus concentration in such juice.

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[4] W. N. Takahashi and Ralph J. Christensen, SCIENCE, 79: 415–416, 1934.

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SCIENCE

VOL. 81 FRIDAY, MARCH 29, 1935 No. 2100

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

PHARMACY'S UNFINISHED TASKS[1]

By Dr. ROBERT P. FISCHELIS

PRESIDENT OF THE AMERICAN PHARMACEUTICAL ASSOCIATION

THE preparation, standardization and dispensing of drugs and medicines constitute an activity which is indispensable to good medical care. How, where and under what conditions this professional activity can be carried on with greatest benefit to all concerned is a question that has been agitating many minds ever since the use of drugs in the treatment and prevention of disease became a part of the practice of medicine. It is not necessary to justify the existence of a separate group of practitioners to whom has been assigned the function of compounding and dispensing medicines. Pharmacists have made an important place for themselves among those engaged in providing good medical care to the people of all nations. The evidence of a changing attitude on the part of the public toward the organization of medical services, however, makes it advisable to examine, from time to time, our existing methods of furnishing pharmaceutical service and the systems by which such service is controlled.

The practice of medicine has been subjected recently to some searching inquiries on the part of professional and lay groups who are interested in providing medical care for all the people in fullest measure at a price they can pay. These inquiries have naturally included studies of pharmaceutical practice, and some interesting facts have been developed which should not be lost upon those most interested in the future welfare of the profession of pharmacy.

When we speak of pharmacists we do not necessarily limit ourselves to persons operating retail drug stores. As a matter of fact, a great deal of the practise of professional pharmacy is carried on to-day in places far removed from the corner drug store. The manufacturing function of the pharmacist, especially

[1] Part of an address delivered at the Third Annual Pharmaceutical Conference of the College of Pharmacy of the University of Michigan.

that which is carried on upon a large scale, has been transferred to a very great extent from the retail drug store to the laboratories of manufacturing houses. The ordinary retail drug store has become very largely a distributing center for manufactured products, although much small-scale manufacturing is still carried on, in some retail drug stores, and nearly all of them engage in the extemporaneous compounding of prescriptions. Hospitals, medical centers, group clinics, manufacturing and research laboratories, as well as college classrooms and laboratories and governmental offices and laboratories, are other centers of activity in which pharmacists carry on their specialized function.

Recent surveys indicate that less than 10 per cent. of the retail drug stores of the United States carry on a sufficiently extensive prescription practise to maintain themselves economically, while the other 90 per cent., or more, although prepared and equipped to supply prescription service when, as and if needed, are able to do so only because their establishments are used to supply other services and commodities at a reasonable profit. In short, the public has cheerfully subsidized the professional services of the corner drug store for emergency needs by making it a source of supply for many related and unrelated commodities and non-professional services.

The drug store as a social institution has made a place for itself in every community. However, the profession itself has been unable to control the number of establishments seeking to supply pharmaceutical service, and no attempt has been made by our federal, state or local governments to regulate the supply of establishments organized to give pharmaceutical service. What is more, the attempt to regulate the quality of service has been rather limited. All states require some form of licensure of those who wish to qualify as pharmacists. Many states also have a licensing system which serves to control the establishment of pharmacies. However, the requirements for obtaining a license to operate a pharmacy offer no great hindrance to any one desiring to open such an establishment and carry on a business in drugs if registered pharmacists are employed. Hence the public control of the drug business leaves much to be desired.

Not only is there lack of uniformity in the licensing requirements for pharmacists and for the operation of pharmacies, but there is also, even in this enlightened day, considerable opposition to a strict legal control of the compounding and dispensing of drugs and medicines. Pharmacists by their training acquire a wholesome respect for the dangerous nature of the drugs and medicines with which they come in daily contact. This respect is not shared by the general public, if the attitude of many of our legislators is any criterion of public opinion.

The blame for this situation undoubtedly rests very largely with the profession itself. We have been entirely too careless in preserving our professional prerogatives. Little by little we have permitted the encroachment of unfriendly interests upon our domain. If such a situation were merely detrimental to the profession of pharmacy, it would be of only passing interest to the world at large.

Extent and Type of Service

We have, in the course of years, developed between fifty-five and sixty thousand "service stations" throughout the United States which are known to the average citizen as drug stores. We like to call them pharmacies because in our minds there is a distinction. The number of drug stores has developed consistently with the development of our national population. It has remained at a level of about one store per two thousand people for the last forty years, although the distribution is by no means as satisfactory as these figures imply. These "service stations" have endeavored to adjust themselves to the needs of the community in which they exist. We have the small country drug store serving rural communities, filling comparatively few prescriptions, because physicians in these districts carry their medicines, to a great extent, but stocking large numbers of ready-made medicines, "patent" medicines, home remedies, and also a great variety of unrelated merchandise. By virtue of the commerce in unrelated articles, this type of store is able to make a living and at the same time it is prepared to supply such professional services as may be called for when the occasion demands it.

We have also developed the neighborhood type of pharmacy in our larger communities and in metropolitan centers. Here the compounding of prescriptions and the dispensing of drugs and medicines is interspersed with a wide range of commercial activities, again for the purpose of maintaining the establishment so that its professional services may be available when needed. We have furthermore developed in some of these larger centers prescription pharmacies in which merchandising activities are reduced to a minimum. Such establishments are few in number. They furnish a marked contrast to the chain-store type of drug store in which high-pressure sales methods are applied to the distribution of ready-made medicines and general merchandise alike.

Undoubtedly there is a distinct need for the dramatization of the professional services rendered by the pharmacist. We may think the public is acquainted with the educational requirements for entrance into the profession of pharmacy, but the facts are that

even members of the medical professions are not all familiar with the advances that have been made in the requirements for pharmaceutical licensure in recent years If the professions do not know it, certainly the public is even more ignorant of the advances in pharmacy

Twenty five or more years ago, some of our pharmaceutical journals began to urge pharmacists to "get out of the rut" and give shelf space to fast selling ready made medicines, toilet articles or general merchandise, and relegate the ornate and impressively decorated shelf bottles and other containers to the rear or the basement of the store There was a rush to follow this advice, and as time went on and the mysteriously labeled containers of tinctures, fluid extracts, chemicals, powders and crude drugs were removed from public gaze, the professional function of the pharmacist passed out of the public mind to a considerable degree To-day, after twenty five years or more of hiding the evidence of professional activity, a new crop of pharmaceutical editors is urging pharmacists to bring their prescription departments out into the open and rearrange their stores so that the public can see what goes on in the prescription room and laboratory of the store Just as blindly as the advice to relegate all professional fixtures to the back room and cellar was followed years ago, so to day many are following the advice to remove all privacy from the prescription room and let the public watch the pharmacist prepare the medicines they are going to take It may be necessary to counteract the previous removal of all outward signs of professionalism from the front part of the drug store with the sudden exposure of the entire professional activity of the drug store to the public gaze, but it is to be hoped that a happy medium will soon be found which will settle us, for a time at least, somewhere between the extremes of commercial overdress and professional nudism

Relation to Medicine

The practise of pharmacy is fundamentally a subdivision of the practise of medicine The practise of medicine is essentially an art which involves the intelligent application of many sciences In the practise of medicine, as in every other field of activity, there must be a division of labor We, therefore, have the diagnostician, the surgeon, the internist and the many specialists who, although trained in general medicine, have chosen to devote their life activities to one branch of the practise of medicine and have become experts in their particular field In addition to the practitioners of medicine, there is a vast army of medical scientists who may or may not be trained in the practise of medicine as a whole, but who have mastered one or more of the arts or sciences without which the practise of medicine would be severely handicapped Under this heading come the pathologists, bacteriologists, roentgenologists, biochemists pharmacists and others Many of these medical scientists are trained in general medicine as well as in their own specialty It is not rare, however, to find pathologists, roentgenologists and biochemists who are not doctors of medicine, and probably a majority of bacteriologists are not physicians There are physicians who have specialized in the various branches of chemistry and in pharmacy, but by far the larger number of persons engaged in chemical and pharmaceutical work are not physicians

If we look upon pharmacy as one of the specialized branches of the practise of medicine, we are, in a way, subordinating it to the practise of medicine as a whole I see no disadvantage in this, although I am cognizant of attempts to look upon the practise of pharmacy as a separate entity These attempts are, to my mind, undermining the solid foundation upon which professional pharmacy rests

It is the function of pharmacy and the duty of the pharmacist, whether he plays the part of large or small-scale manufacturer, compounder or dispenser, to serve the physician and the public in the preparation, compounding and dispensing of therapeutic agents drawn from mineral, animal or vegetable sources In the manufacturing laboratory, the pharmacist is a manufacturer In the retail drug store he is a compounder and dispenser In the research laboratory he may become the discoverer of new and better methods of administering drugs or he may devise new combinations of drugs or carry on important syntheses These divided functions overlap at times, but they are becoming more and more distinct as time goes on It is hardly conceivable that the need for extemporaneous prescription compounding will ever be eliminated It is certain, however, that less and less manufacturing will be done by the prescription pharmacist and that supplying simple and mixed pharmaceuticals in ready dosage forms, such as tablets, capsules, ampuls, etc, will increase to the point where extemporaneous compounding will be materially reduced

Believing pharmacy's place in the art of medicine to be by its very nature auxiliary to medicine itself, it follows that there must be close cooperation with the medical profession if the dignity of the latter, as well as its high standing with the public, is to be reflected in the profession of pharmacy

Three Fundamental Tasks

Underlying the continuance of a professional status for the pharmacist are three fundamental tasks, to the completion of which forward looking members of the pharmacal profession long ago dedicated themselves

(1) A program of education commensurate with the professional responsibilities to be assumed by the pharmacist

(2) The advancement of legal and professional requirements for pharmaceutical licensure throughout the United States

(3) The development of a professional solidarity among the practicing pharmacists of the United States for the furtherance of their scientific and economic objectives

In the field of pharmaceutical education much has been accomplished, but much remains to be done Shortly after it was decided that the minimum course in pharmacy should be raised to the level of the baccalaureate standard of training in other fields of education, it became apparent that such a minimum program meant a variety of things to different individuals and groups in the field of pharmaceutical education The publication of the National Pharmaceutical Syllabus with its outline of a curriculum for the four year course, has not clarified the situation to the extent that one might reasonably expect There are still educators in the field of pharmacy who talk in terms of hours and credits as though education could be reduced to a mathematical basis and be administered in standardized doses to groups of individuals whose one outstanding group characteristic is lack of uniformity in mental equipment, in aptitude and in educational background In this connection, one is reminded of the discussions in the early days of standardization of pharmaceutical products by means of physiological assays Pharmacologists reported that there was wide variation in their results of the determination of the physiological activity of tincture digitalis upon frogs Some one slyly remarked that since the pharmacologists were all experts and their technique appeared to be perfect, the difficulty must be with the frogs, and therefore the thing to do was to standardize the frogs As a matter of fact, methods have since been devised of measuring variability in the reaction of frogs to digitalis, but whether we can succeed in so altering or selecting the human beings coming to us for education in pharmacy that education in standardized and measured units may be applied to all with equal success is at least doubtful

The tendency in elementary and secondary education is in the direction of greater individual attention to the student and a development of the faculties for which he shows a particular aptitude In our colleges of liberal arts and sciences the trend is in the same direction It is presumed, of course that when an individual selects a professional course he is doing so because he has definitely made up his mind that it is a field in which he desires to work, and, furthermore, that he has certain capabilities which will make it possible for him to qualify in this field It is hardly fair, however, to place the entire responsibility upon the student The college of pharmacy which accepts him has a certain responsibility which it should not shirk One of the unfinished tasks of pharmaceutical education is the development of methods of selecting personnel from which future pharmacists are to spring Unless the next generation of pharmacists develops a type of leadership which will carry the profession into fields of activity that are more nearly in line with developments in medicine and dentistry, we must look forward to a diminution of professional activity in the drug stores of the United States, and an increasing absorption of the professional function of the pharmacist by group practitioners and institutional organizations

The recent attempt to include in a four year course the cultural and basic education which it is acknowledged should precede the more technical training of the pharmacist may or may not be successful Already we are hearing an increasing volume of critical comment against the present arrangement It would not be at all surprising to find that within the next five years colleges of pharmacy everywhere will do what is now being done in some of our universities, namely, devote their entire time and attention to the technical training of pharmacists who will qualify for admission to the pharmacy course by completion of a pre pharmacy course of one or two years or perhaps graduation from a junior college It is interesting to note in this connection that a study of the freshman enrolment in pharmacy colleges for the past ten years, throughout the United States, shows a gradual but steady decrease in the number who are choosing pharmacy for their life work In 1924 sixty six colleges of pharmacy in the United States enrolled 5,288 freshmen In 1933 these colleges enrolled 2,469 freshmen This represents a drop of 53 per cent The drop has been gradual, but steady, up to 1930 In 1931 it was very slight In 1932 however, it was extremely abrupt This is, of course, due in part to the depression and in part to the four year course How much of the drop has been due to increasing standards is a matter of interest As a basis for comparison, we have the statistics for the schools belonging to the American Association of Colleges of Pharmacy, all of which began the four year course in 1932 or previously, and the schools of pharmacy in the State of New York which are not members of the association of colleges and which are not yet on the minimum four year course basis The figures are as follows 66 colleges of pharmacy throughout the United States showed a drop in enrolment in the freshman classes of 39 2 per cent between 1929, which was the peak

year of the boom period, and 1932, the year during the depression when the four year course went into effect Fifty two of the 55 colleges of pharmacy holding membership in the American Association of Colleges of Pharmacy dropped 36 4 per cent in the enrolment of their freshman classes during the same period The six New York schools dropped 46 per cent in their enrolment from 1929 to 1932 As they did not adopt the four year minimum course in 1932, and as their drop in enrolment is greater than that of the schools which did increase the requirement in 1932, and also greater than the drop in all schools, it is safe to assume that whatever drop in enrolment there has been is due more largely, if not entirely, to the depression and to an increasing lack of interest in pharmacy as a career than to the increase in educational requirements

The training for leadership in pharmacy can not be completed in the minimum pharmacy course An effort must be made to select from among graduating classes a certain few who appear to possess the qualities which make for constructive leadership and the promotion of professional idealism These selected representatives of our graduating classes must be given an opportunity to develop not only in scientific fields, but in the field of economics as applied to pharmacy, in the field of law enforcement as applied to pharmacy and in the field of teaching as applied to pharmacy Unless greater opportunity is provided to train leaders in pharmaceutical thought, just as we have already provided for the training of leaders in the development of science as applied to pharmacy our growth will be one sided and we will continue to turn out a group of skilled pharmaceutical scientists on the one hand, a lot of mediocre practitioners on the other hand, with but few properly equipped leaders to guide the progress of the many in their attempt to apply the art and science of pharmacy to the problems that daily arise to plague the retail druggist

Licensure and Law Enforcement

In the field of pharmaceutical licensure and law enforcement there are many major unfinished tasks There is not sufficient uniformity in the regulations governing the practise of pharmacy and the dispensing of drugs and medicines in the various states of the Union Fortunately, the American Pharmaceutical Association has had its attention called very forcibly to this situation, and it is hoped that with the completion and endowment of the headquarters in Washington it will soon be possible to undertake studies which will establish the facts about the existing order and lay the foundation for sorely needed reforms

When the public once becomes conscious of the laxity with which the sale of drugs and medicines is controlled in the United States, it may be expected that drastic changes will be advocated and put into effect

On the assumption that persons familiar with the practice of pharmacy and engaged in that practise are best equipped to regulate it and to determine who is and who is not fit to practise it practically all the laws governing the practise of pharmacy in the United States provide that boards of pharmacy shall be composed of licensed pharmacists who have spent a certain number of years in active practise and who are engaged in the retail drug business In theory, no fault can be found with such an arrangement In practise, however, it frequently does not work out Some state laws provide that the persons to be appointed to boards of pharmacy shall be recommended by state pharmaceutical associations They further provide that in making recommendations for the appointment a certain number of those recommended shall be of one political faith and an equal number of the opposite political faith Just what this has to do with the competence of an individual to judge whether an applicant is fit to practise pharmacy or not is not apparent Just what bearing the political faith of a board member may have upon law enforcement is, however, quite apparent There are states in which the political phase does not enter into board appointments at all This does not mean that political pressure is not brought from time to time upon board members to do things which will favor certain individuals However, if board appointments in the first place are made without political consideration the board member is in a position to resist such pressure and hew to the line, regardless of the consequences

The difference in educational standards in the various states the difference in the personal standards of appointees to the boards of pharmacy and the difference in legal standards for the enforcement of regulations governing professional practise are so great that it is a tribute to pharmacy in general that things have gone along as well as they have How to bring backward states into line and what to do to impress members of a legislature with the importance of fair and honest regulation of the practise of pharmacy constitute a problem to which pharmaceutical organizations and high minded pharmacists have devoted much time and attention Considerable headway has been made, but much remains to be done

The make up of boards of pharmacy at the present time is such that the public is apt to accept at its face value the argument that pharmacy laws are being enforced for the benefit of pharmacists rather than for the benefit of the public This is particularly true when it comes to the sale of drugs and medicines through outlets other than established retail drug stores Unfortunately, the public loses sight of the fact that drugs and medicines and even packaged or

patented medicines are not mere merchandise Many a proposed pharmacy law has been defeated in the legislature because of pressure brought by patent medicine interests and general storekeepers who feared a loss of trade and were able to convince members of the legislature that pharmacists were seeking monopolies Perhaps the time has come in states where legislation for the regulation of the practise of pharmacy has been difficult to obtain to ask for the appointment of a commission of high minded and public spirited citizens to study the respective arguments and claims of those who favor and those who oppose legislation affecting the practise of pharmacy Such a commission would soon be able to determine the relative merits of the claims made and would silence the opposition of those who are instrumental in withholding advancement of standards for pharmaceutical licensure, for no good reason

Perhaps the time has also come when various states should add to their boards of pharmacy high standing laymen of the type usually appointed by our governors to managing boards of institutions or to health departments Such a lay board member would not be expected to act as an examiner of applicants for registration but he should be expected to sit with the professional members of the board at hearings involving violations of the pharmacy act and in meetings where matters of public policy with respect to the sale of drugs and medicines are considered

The addition of such lay members to boards of pharmacy, or to any other professional boards, for that matter, would add a view point which would be very helpful, especially in these days when talk of socialization of the activities of members of the healing arts occupies such an important place in public and private discussion They would also be in a position to act as interpreters of the view point of the pharmacy board to the public

A National Examination

Another very helpful step in the improvement of standards of licensure as well as standards of pharmaceutical practise, would be the launching of an effort to provide a uniform nation wide examination in the fundamental subjects now given by the respective boards of pharmacy

I have proposed that the National Association of Boards of Pharmacy conduct such an examination annually and simultaneously for the graduating class of every college of pharmacy in the United States, and that the results of this examination be certified to every board of pharmacy in the United States so that graduates of the respective colleges of pharmacy may receive permanent credit toward a registered pharmacist's certificate for these examinations if they pass them. It would then be necessary for the applicant merely to submit, to the state board from which he desires to obtain a license, evidence of his personal qualifications and practical experience, and to be given a practical examination in the compounding and dispensing of drugs and medicines Not only would such an annual national examination be an advantage to the prospective registrant because he would be able to qualify at a time when he is best prepared to do so, but it would also give confidence to all boards in the fitness of an applicant who may come into a state by reciprocal registration years later Every board would know that political or personal influence had no bearing on the candidate's examination record At the same time, each board would still maintain its prerogative of examining the applicant in the work in which it is most competent to test him, namely, the practical conduct of a pharmacy and the compounding and dispensing of medicines Such a national examination would not be without influence upon the colleges of pharmacy, for it would act as a stimulus toward more careful study of the quality of teaching and testing within these institutions, inasmuch as their products will be measured by a common yard stick

Professional Solidarity

The final unfinished task to which I desire to refer is that of developing a professional solidarity within our ranks which will do for pharmacy what is being accomplished in medicine, dentistry, chemistry and many other fields

We suffer not from a lack of organization or organizations, but rather from over organization Yet with all the state and local associations of pharmacists scattered over this broad land, and with two national organizations ready and willing to function respectively in the professional and economic fields, it must be confessed that no existing organization can to day truthfully claim to speak authoritatively for the profession as a whole It seems clear that the approach to professional solidarity must contemplate a complete understanding of the relative functions of our two national associations, a definite liaison between local and state and state and national associations such as we have in medicine and in dentistry, and the development of a mutual confidence which will throw the full weight and power of the individual pharmacist into his local association, that of the local association into the state association, and that of the state associations into both national associations It will then remain for the two national associations to arrive at a basis for mutual helpfulness and cooperation. Those occupying high places in these national associations must bear in mind that they are the custodians of the ideals of the profession, of the beliefs its members cherish and of the faith which makes a unit of a mere aggregation of individuals

OBITUARY

WALTER JONES

WALTER JONES, professor emeritus of physiological chemistry at the Johns Hopkins University, died in Baltimore on February 28, 1935, at the age of seventy years He is survived by his wife and daughter

In 1927, when he retired because of ill health Walter Jones had served the School of Medicine thirty one years, first under the leadership of Professor John J Abel and from 1908 as professor of physiological chemistry He had received his A B from "The Hopkins" in 1888 and his Ph D in 1891 Thus he completed nearly a lifetime of association with a university founded in the city of his birth There were short periods at Wittenberg College and Purdue University and of study abroad

It was at Marburg, as an ardent student of the elder Kossel and an admirer of the pioneer Friedrich Miescher, that Jones found his field to be the chemistry of the nucleic acids His monograph, "The Nucleic Acids," remained for a long time a standard treatise on this difficult subject in which center the clinically important topic, purine metabolism, and the cytologically important problems which are destined to depend upon the characterization of these cell constituents One who has not lived with this subject will have difficulty in appraising the work of contributors and I shall leave to more competent hands a review of Jones's work Yet I think it evident that his place can not be described merely by the naming of particular discoveries He had a part in bringing a complicated subject out of obscurity If, during the exposure and preliminary dissections, mistakes were made, they were of the sort which stimulated advances In the final conclusions many of Jones's substantial contributions are embedded

For his eminence as an investigator Dr Jones was made a member of the National Academy of Sciences and twice president of the American Society of Biological Chemists

An aspect of Walter Jones's character that deserves mention is found in his relation to students Temperamentally impatient with mediocrity he attracted to his own field of research a select group of medical students as well as assistants In his bibliography will be found as joint authors names remarkable for the preponderance of their association with later acquired distinctions In short, Jones detected ability Many a run of-the-mine student had painful experiences, and yet Jones's colleagues attest to the care with which he prepared to meet the needs of raw recruits This was particularly true of his lectures, and they were brilliant. It is not often that a lecturer can recapture the attention of those who have passed a required course Yet upper classmen returned year after year to the old hall where Professor Jones presented the elements of physiological chemistry to first year students Doubtless they did so partly for the occasional entertainment, but, on the whole, it was clearly for the inspiration Many, indeed, were the occasions when entertainment was afforded, as when a forgetful student was startled by the assertion that even a street car conductor should know all the amino acids or when a polemic with Schittenhelm was exposed in all its gory detail It has been said that there were periods when a student might have gotten the impression that the whole of physiological chemistry was concerned with nucleic acids and related subjects Doubtless weathering has made prominent the tougher strata of memories Yet, even if the charge were true, it would be easy to find good reason Intense concentration was Jones's habit Furthermore, he hated bluff He would offer admission of dim memory before admission was demanded He would speak only fully catalyzed thoughts He was never bound by classic definitions of his subject Capable as he was of the exposition of diverse subjects he gave to his students only the best that was in him at the moment In so doing he gave far more than the immediate subject matter The better students appreciated this at the time and in later years they bring back tales which make a fine tradition

The high intensity at which Walter Jones's energy was displayed made him a person difficult to appreciate by those who were unprepared A flame might burst forth at the lunch table or the bank teller's window People grew nervously expectant Unagile minds, like my own, seldom caught up with even the kindling of the flame, were left uneasy and inclined to avoid future consternation Yet when the flame appeared after the rendering of a symphony or during the discussion of a book one knew that here was a man who had lived with the composer or achieved with the hero while holding the critic's appraisal of the work of art To Walter Jones's unique synthesis of the emotional and the logical few could rise and those who could inevitably failed to sustain themselves Perhaps it was when he detected evidence of lagging that he brought forth those prickings of belief and custom and convention that might awaken the dozing listener Even so it may be doubted that any one could resolve the whimsical, the mischievous and the serious elements It was, of course, inevitable that bits of the mischievous not always would harmonize with the amenities, but he who would make much of this should remember the unswerving loyalty of friends This speaks volumes

It was this high level of intensity, at which alone

his abilities would work, that explains Walter Jones's premature disappearance from the annals of biochemistry After his official retirement and when better health permitted, he was ushered into a new laboratory planned for his use For a moment the old eagerness returned, for a few hours laboratory equipment took form, then a sudden disappearance and no return A more placid mind could have given us those slowly ripening fruits of age that are needed by a generation accustomed to the strenuous life Walter Jones knew only and loved only the strenuous life and when the body could no longer respond fully to the iron will he felt his career to be ended Thence forth a complete silence in all scientific matters must have concealed what we can only guess

If a mind so independent can be said to have harbored ambitions for recognition, three such ambitions were fulfilled Walter Jones attained an honorable and honored place in the history of his chosen science He commanded the respect of his students as an inspiring lecturer He won the loyalty of those who labored with him These are not the least of possible attainments, and from an imperfect acquaintance enriched at his fireside in the hills of Maryland I am led to suspect another, more satisfying to the man himself It must have been that had the gods permitted the removal of disguise he could have told us something of Olympus for there were moments in his discussion of great matters in literature and music when he spoke as one who feels that it is given to the gods to know one another when they meet '

WM MANSFIELD CLARK

THE SCHOOL OF MEDICINE
THE JOHNS HOPKINS UNIVERSITY

ALBERT MANN
1853–1935

THE Diatomaceae have but few students in North America, in fact throughout the world, due, somewhat, to the difficulties attending their study The passing of one of these students recognized not only as the dean, but also as the foremost authority here, is of inestimable loss to those enthusiasts who have been attracted by the beauty and symmetry of these lowly plants

Dr Albert Mann died at his home in Middletown, Conn, on February 1, 1935 He was born at Hoboken, N J, on June 30, 1853, the son of Albert and Lydia Helen (Everett) Mann Educated at Wesleyan University, Middletown, he graduated in 1879, where later the degrees of M A and Sc D were conferred, and then continued studies for the ministry at Drew Theological Seminary until 1880 On October 6 of that year, he was married to Jennie F Yard of Trenton, N J, who survives him with a son Albert, born in 1883, and now professor at Wesleyan University From 1880 to 1892, Dr Mann was pastor of various churches, in Philadelphia, Verona, N J, Bloomfield, N J, and Newark, N J

It was in the early years of his pastorate, in Philadelphia, that he met the late Charles H Kain, a well known diatomist of his day, and then began that interest in the diatoms which continued throughout his life While resident in New Jersey, he was active in microscopical circles as member and vice president of the old Essex County Microscopical Society, specializing in the diatoms, and in the last year of his pastorate in St Luke's M E Church, Newark, he prepared his first paper on the group, entitled, "List of Diatomaceae from a Deep sea Dredging in the Atlantic Ocean off Delaware Bay by the U S Fish Commission Steamer Albatross" The paper was published in the Proceedings of the United States National Museum, Vol XVI, pages 303–312, 1893

Severing his official connections with St Luke's M E Church to enter on a scientific career, he left for Germany in 1892 to study at the University of Munich, where, on graduation in 1894, he received the degree of Ph D On his return to the United States he was tendered the chair of professor of botany at Ohio Wesleyan University, which he filled until 1900 The following years, up to 1905, were spent as collaborator of the University of Munich, and in scientific investigations at the Smithsonian Institution in Washington The spare hours were used for the research work necessary to the preparation of the exhaustive 'Report on the Diatoms of the Albatross Voyages in the Pacific Ocean 1888–1904," which appeared in 1907 In 1905 he commenced the long services, lasting 14 years, as a scientific specialist in the U S Department of Agriculture, in Washington, and in the early part of that period was also professor of botany at the George Washington University

It was not until 1919 that Dr Mann realized the fulfilment of his dream—the establishment in Washington of a laboratory, solely for diatom research, with himself in charge as an associate of the Carnegie Institution Suitably installed in the Smithsonian Building, it soon became headquarters—as he called it—for students and others interested in the economic uses of the diatoms With more time at his disposal, the large, important, taxonomic paper on the "Marine Diatoms of the Philippine Islands" was published in 1925 Many smaller papers were written then and during earlier periods of his life, on diatoms and other subjects related to his professional work, but space will not permit the listing here Research work commenced and unfinished at the time of his death will be continued, it is hoped, by one of his associates at the laboratory

Dr Mann was a member of the American Association for the Advancement of Science since 1894, and a fellow since 1911, a member of the Cosmos Club of Washington for many years, and a member or fellow of many other scientific organizations

Endowed with high mental qualities, and, having a profound knowledge of the fields into which an active and varied career led him, his contributions to a study commenced in early manhood as a hobby are of the highest importance Sterling character, charming personality and kindliness of spirit endeared him to his friends His passing is sorrowfully noted by one who regards the period of the friendship of many years as one of the happiest of his own life

ROBERT HAGELSTEIN

NEW YORK BOTANICAL GARDEN

MEMORIALS

THE aeronautical laboratory of the Rensselaer Polytechnic Institute, built at a cost of $500,000, has been named the Ricketts Building, in memory of Dr Palmer C Ricketts, president and director of the institute for more than fifty years Dr Ricketts died last December

THE Board of Managers of the New York Botanical Garden at its annual meeting designated the general herbarium of the garden as the Britton Herbarium, in honor of Dr N L Britton, lately director of the institution The reference collections, in all units, now contain 1,774,687 specimens, a collection particularly rich in types and in historical material

CORNELL UNIVERSITY has unveiled a bronze memorial plaque commemorating the achievements and service of the late Stephen Moulton Babcock, the inventor of the Babcock test The cast is a replica of the one executed by the sculptor, Lorado Taft, and presented to the University of Wisconsin by friends of Dr Babcock in October, 1934

A PORTRAIT of Lavoisier, "father of modern chemistry," and his wife has been presented to Yale University by the students and associates of Dr Lafayette B Mendel, Sterling professor of physiological chemistry The painting will eventually hang in the seminar room of Dr Mendel's department Permission was granted by the trustees of the Rockefeller Institute for Medical Research to copy this painting by Jacques Louis David, which was acquired by John D Rockefeller, Jr, in 1925 and now hangs in the library of the institute

THE German Rontgen Society has recently had a memorial tablet erected to Rontgen at Pontresina in the Engadine, where for more than forty years he spent his annual holiday

A RESOLUTION providing for the transfer of the bodies of Pierre Curie and Mme Marie Curie to a tomb in the Paris Pantheon has been approved by the education committee of the French Senate The tomb will be beside that of the chemist, Marcellin Berthelot

RECENT DEATHS

THE body of Dr George H Bigelow, director of the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary, Massachusetts State Commissioner of Public Health from 1925 to 1933, who disappeared on December 3, was found on March 23 in a reservoir near Framingham, Mass where he was born Dr Bigelow was forty four years old

DR GEORGE EDWIN JOHNSON, professor of zoology and mammalogist of the Agricultural Experiment Station, Kansas State College, died on March 18, at the age of forty five years A correspondent writes Dr Johnson had made a considerable contribution to the knowledge of the physiology of hibernation He had been for eight years the efficient secretary of the Kansas Academy of Science

SCIENTIFIC EVENTS

MEASUREMENTS OF GRAVITY OVER THE NIPPON TRENCH

IN the *Proceedings* of the Imperial Academy of Tokyo, Japan, for December, 1934, is an article entitled 'Measurements of Gravity over the Nippon Trench on Board the I J Submarine Ro-57," by Motonori Matuyama, which should interest all those who are dealing with the configuration of the ocean bottoms

According to Dr Matuyama's article, a pendulum apparatus of the Meinesz type was purchased in Holland and was delivered in Japan in July, 1932 The instrument was given a careful examination in the laboratory of Dr Matuyama and a few changes were made in some of the smaller or minor parts of the apparatus In October, 1932 the apparatus was put aboard the submarine Ro-58 to do some practice work in measuring gravity in Sagami Bay The submarine dived five times in two days

The first real gravity survey by Dr Matuyama was made over the Nippon Trench in October, 1934, aboard the submarine Ro 57 commanded by Commander A Hudii He was accompanied by N Kumagai and two assistants Junior Captain T Akiyosi, a member

of the Hydrographic Office, was ordered by the Imperial Navy to sail on the submarine and to help in the management of the expedition Dr Matuyama spoke highly of the assistance rendered by Captain Akiyosi, especially in determining the positions and velocities of the submarine

During the trip 27 measurements of gravity were made during twenty five submergences of the submarine In two cases 2 measurements were made as checks during a single submergence

At the time of writing his paper for the *Proceedings* the photographic records and other data connected with the gravity surveys were being carefully studied and it is expected that the final results will be published later Approximate values of gravity have been calculated and the results are shown on a map accompanying Dr Matuyama's article together with the free air gravity anomalies It is hoped that these gravity stations may be reduced by the isostatic method in order to throw some light on the isostatic condition of the crust under the Nippon Deep and surrounding areas

W B

STREAM SURVEYS OF THE NATIONAL FORESTS AND PARKS

During 1934 the Bureau of Fisheries sent sixteen field parties to the different national forests and national parks for the purpose of studying and reporting on the physical chemical and biological conditions of the streams and lakes lying within the forest or park areas With this accumulated information as a basis, the aim was to improve the fishing in these areas by adopting a policy of planting the species size and number of fish for which each surveyed stream or lake is best adapted

However, the forests and parks were not the only ones to benefit from such a survey The Bureau of Fisheries has accumulated a great deal of information which may be valuable in the future The information can hardly be called new, but it is a more concise and quantitative statement of what is rather generally known

In the East the four parties surveyed, completely or in part the Great Smoky Mountain National Park in Tennessee and North Carolina and the following national forests Green Mountain and White Mountain in New England, George Washington and Monongahela in Virginia and West Virginia and Pisgah and Nantahala in the two Carolinas and Georgia

In the West the twelve parties surveyed, completely or in part, Glacier National Park and the following national forests Sierra, Shasta, Klamath, Monoluyo, Coconino, Santa Fe, Humbolt, Roosevelt, Wasatch, Tonto, Crook, Coronado, Teton and Wyoming

Comprehensive reports were compiled from the individual report blanks These enlarged reports give a description of the methods of survey, a brief account of the physiography of the region, a list of the fishes found in the region, a statement of the natural enemies of fish present, a discussion of the kinds and relative abundance of aquatic fish food notes on the water fluctuations of the streams and lakes and comments on the accessibility of the waters and the fishing intensity Included with each of the reports are tables giving the following information about the streams length, average width, average depth, average volume, gradient, character of stream bed vegetation, pool grade food grade, abundance of shade, game fish present degree fished, fish recommended for stocking, size section to be stocked, length of section, number of fish per mile, frequency and remarks For lakes a table is included which gives the following area elevation, maximum and average depth, bottom food, plankton, vegetation, character of bottom, whether lake is natural or artificial, extent of shoals, degree fished, fish recommended size number, frequency and remarks These tables are designed to furnish the Forest and Park Services with the major characteristics of each lake and stream and to give stocking suggestions for these waters

THE JOHNS HOPKINS UNIVERSITY RESEARCH CONFERENCES ON CHEMICAL PROBLEMS

THE chemistry department of the Johns Hopkins University is holding its fifth Research Conference this summer at Gibson Island near Baltimore The conference will be under the general direction of E Emmet Reid and will run three weeks from June 24 to July 12 The plan is flexible, varying from day to day according to the nature of the topic under discussion and the wishes of those participating The day begins with a more or less formal lecture outlining some field of research and directing attention to its unsolved problems This is followed by a discussion in which each one present takes part, making what contribution he can to the solution of the problems presented The ideal is to have a group large enough that all points of view may be represented, yet small enough that all who wish may take active part The plan is to have recognized leaders in each field of research give the lectures and start the discussions, but its success depends on having a number in the group who are capable of contributing ideas The remainder of the day is left to sports or conversations These conferences are intended to combine mental stimulation pleasant personal contacts and healthful recreation The Gibson Island Club generously shares its facilities for this period The club has an excellent golf course, fine tennis courts, splendid swimming and beaches, with ample dressing rooms

and commodious club house There is excellent fishing in the surrounding Chesapeake Attendants on the conferences may secure rooms in the club house or in adjacent cottages or may come from Baltimore for the day Meals for all are served at the club house

The program given below is to be regarded as a tentative outline to be filled in or modified as may seem best

1 *The Chemistry of the Aliphatic Free Radicals* Professor Francis O Rice, June 24–28

The week's conferences will include a series of lectures and discussion on (1) the preparation and properties of free aliphatic radicals, (2) the mechanism of thermal decompositions from the free radical standpoint, and, (3) the Haber Willstätter chain mechanism applied to reactions in solution

2 *Long Chain Molecules* Dr Thomas Midgley, Jr, July 1–5

July 1	Formation of polymers by definite chemical reactions, rings and string molecules, Dr W H Carothers
July 2	Synthetic rubber, Duprene and Thiokol, Dr W H Carothers and Dr J C Patrick
July 3	The determination of molecular weights of big molecules, Dr E O Kraemer
July 4	Cellulose, Dr E O Kraemer
July 5	Rubber, Dr T Midgley, Jr

3 *Vitamins* Dr E V McCollum, July 8–12

These conferences consist of lectures and discussion grouped around work in progress on vitamins

July 8	Vitamin A, Dr E V McCollum
July 9	Vitamin B, Dr R R Williams
July 10	Vitamin C, Dr C G King
July 11	Vitamin D, Dr C E Bills
July 12	Vitamin G, Dr H C Sherman

NEIL E GORDON

THE JOHNS HOPKINS UNIVERSITY

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY

IF we may judge from the results of two years, the conference symposia method as developed at the Biological Laboratory at Cold Spring Harbor is a successful experiment in method The cooperation of outstanding chemists, physicists and mathematicians, as well as biologists, has been most gratifying The unique bringing together of knowledge from these various sources upon a fundamental aspect of biology each year is already widely appreciated Thus the annual volume resulting from the symposia and discussion is purchased in over twenty five countries all over the world, and there is evidence that the distribution of the volumes is becoming extended

This year the conference-symposia will be centered about photochemistry in biology and medicine They will take place during five weeks, June 26 to August 1 The general aspects which will be considered are basic photochemistry (June 26–July 2), photosynthesis (July 3–July 16), photoreceptors and bioluminescence (July 17–July 23), and photochemistry in medicine (July 24–July 30)

While plans are still incomplete, it is already known that the following men will present papers, and, with five exceptions, will be in residence from one to five weeks at least

Dr Vernon M Albers, physicist, Kettering Foundation, Antioch College, Dr William Arnold, Biological Laboratories, Harvard University, Dr Charles E Bills, biochemist, director, Research Laboratories Mead Johnson and Company, Dr Harold F Blum, assistant professor of physiology University of California Medical School, Dr F S Brackett, physicist, Bureau of Cotton Economics, Department of Agriculture Dr Dean Burk, associate physical chemist, Bureau of Chemistry and Soils, Department of Agriculture Dr E S Castle, assistant professor of physiology, Harvard University Dr M Demerec, investigator, Department of Genetics, Carnegie Institution of Washington Dr N R Dhar, head of Chemistry Department, University of Allahabad (India), Dr Robert Emerson, Biological Laboratory, California Institute of Technology Dr Henry Eyring, physical chemist, research associate Princeton University, Dr Hugo Fricke, in charge of biophysics laboratory, Biological Laboratory, Dr H Keffer Hartline, fellow medical physics, Johnson Foundation, University of Pennsylvania School of Medicine, Dr F Newton Harvey, professor of physiology, Princeton University, Dr Selig Hecht, professor of biophysics Columbia University, Dr O L Inman, director, Kettering Foundation, Antioch College, Dr H V Knorr, physicist, Kettering Foundation, Antioch College Dr Henry Laurens, professor of physiology, Tulane University School of Medicine, Dr H S Mayerson, assistant professor of physiology, Tulane University School of Medicine Dr Harold Mestre, Department of Bacteriology, Yale University School of Medicine, Dr Karl Meyer Department of Ophthalmology, College of Physicians and Surgeons, Dr W A Noyes, Jr, associate professor of chemistry, Brown University Dr Gerhard K Rollefson, associate professor of chemistry, University of California, Dr Paul Rothemund, biochemist, Kettering Foundation for Study of Chlorophyll and Photosynthesis, Antioch College, Dr S E Sheppard, chemist, assistant director Kodak Research Laboratories, Dr Hugh S Taylor, David B Jones professor of chemistry, Princeton University, Dr George Wald, Biological Laboratories, Harvard University, Dr Ernst Wolf, Biological Laboratories, Harvard University, Dr F Paul Zscheile, Jr, Department of Chemistry, University of Chicago

Investigators who wish to attend various symposia and discussion may obtain more definite information, including programs, from the Biological Laboratory at Cold Spring Harbor —R G H

SCIENTIFIC NOTES AND NEWS

THE House of Representatives has passed a bill conferring the Congressional Medal of Honor on Major General A W Greely, the Arctic explorer General Greely celebrated his ninety first birthday on March 27

THE New York New Jersey Alumni Association of the Johns Hopkins University will hold a dinner at the Hotel Plaza, New York City, on the evening of April 5 in honor of Dr Joseph S Ames, who retires as president of the university in June, and of Dr Isaiah Bowman, president elect, now chairman of the National Research Council and director of the American Geographical Society of New York

DR E D MERRILL, director of the New York Botanical Garden and Dr A B Stout, director of the laboratories of the garden, have been elected honorary fellows of the British Royal Horticultural Society and also honorary life members of the Pennsylvania Horticultural Society

THE Hillebrand Prize, awarded annually by the Washington Chemical Society for the best paper read before it during the preceding year, was presented at the Cosmos Club on March 14 to Frederick Rossini, of the Bureau of Standards, for his paper on "The Thermal Decomposition of Alcohols"

THE gold Moulton Medal of the British Institution of Chemical Engineers for 1934 has been awarded to J Davidson Pratt and G S W Marlow, for a paper entitled "Legal Pitfalls for the Chemical Engineer" The Junior Moulton Medal in silver, for the best paper of the year read before the graduates and students section of the institution, was awarded to D Gordon Bagg for his paper entitled "Determination of the Efficiency of a Multi Stage Washer

THE Paris Academy of Sciences has awarded the Jean Dagnan Bouveret prize of 15,000 francs to Drs Auguste Charles Marie and Paul Remlinger for their work on rabies, and the Lacage prize of 10,000 francs to Professor Portier for his physiological studies

Nature states that the University of Toronto has awarded the Charles Mickle fellowship for 1935 jointly to Dr Edward Mellanby and Mrs May Mellanby The fellowship is endowed under a bequest by the late Dr W J Mickle, and is awarded annually to that member of the medical profession who is considered by the council of the Faculty of Medicine of the University of Toronto to have done most during the preceding ten years to advance sound knowledge of a practical kind in medical art or science"

W A S CALDER, delegate director of the general chemicals group of Imperial Chemical Industries, Limited, has been elected president of the British Society of Chemical Industry for the year 1935-36

OFFICERS of the British Institute of Chemistry were elected at the annual meeting on March 1 as follows *President,* Professor Jocelyn Field Thorpe, *Vice presidents,* W J A Butterfield, Sir George Clayton, Dr A E Dunstan, F G Edmed, Dr H H Hodgson and W H Roberts, *Honorary Treasurer,* P H Kirkaldy

DR BENJAMIN LINCOLN ROBINSON has resigned from the Asa Gray professorship of systematic botany and the curatorship of the Gray Herbarium of Harvard University His resignation, though accepted by the president and fellows of Harvard College at the meeting on March 18, is to date from September 1, from which time he has been appointed Asa Gray professor of systematic botany and curator of the Gray Herbarium, emeritus As he completes his service at the close of the present academic year, Dr Robinson will have held the curatorship of the Gray Herbarium for forty three years and will have occupied the endowed chair connected with it for thirty five years Dr Robinson will continue his monographic studies of the *Compositae Eupatorieae* on which he has long been engaged

F TRUBEE DAVISON, president of the American Museum of Natural History of New York City, whose term as alumni fellow of the corporation of Yale University expires in June has been nominated unanimously for reelection

DR WILLIAM T BOVIE, formerly assistant professor of biophysics at the Harvard Medical School and a member of the Harvard Cancer Commission, is continuing his work on the biological effects of rays in the Shannon Physical Laboratory at Colby College

DR REGINALD M ATWATER, for eight years health commissioner of Cattaraugus County, N Y, has been appointed executive secretary of the American Public Health Association The appointment became effective on March 15

DR LEONARD GREENBURG, acting health officer of New Haven, has been placed in full charge of the department of health He succeeds Dr John L Rice, who left New Haven to become health officer of New York City

PROFESSOR LEO M CHRISTENSEN, of the department of chemistry at Iowa State College, has resigned in order to join the staff of the Chemical Foundation His work will be connected with the production of alcohol from farm products and the formulation of legislation fostering its use

WILLIAM BRIDGES, lately of the New York *Sun*, has been appointed editor and curator of publications at the New York Zoological Society He fills the vacancy left by the retirement on December 31 of Elwin R Sanborn

DR ALFRED E EMERSON, professor of zoology at the University of Chicago, left on March 22 for the Panama Canal Zone, where he plans to analyze the effect of changes of temperature, humidity and light upon the social life of termites His headquarters will be on the island of Barro Colorado in Gatun Lake, Canal Zone, where the National Research Council maintains a biological station

DR L J KLOTZ, plant pathologist at the Citrus Experiment Station of the University of California at Riverside, has been granted five months' leave to study disease resistant plants He left Riverside on March 25 for Michigan State College, where he plans to carry on this research

DR. CLARENCE A NEYMANN, associate professor of psychiatry at Northwestern University, sailed on March 16 to give a special course of lectures at Liége, Louvain, Brussels and Ghent He will speak also before the Royal Medical Society of London

DR A RAYMOND DOCHEZ professor of medicine of the College of Physicians and Surgeons of Columbia University, is visiting at the School of Tropical Medicine San Juan, Puerto Rico, where he gave a lecture before the faculty and staff of the school and before the physicians of the island on Influenza and Acute Infections of the Respiratory Tract'

THE Alpha Beta Chapter of Sigma Pi Sigma honorary physics society, at Syracuse University, recently sponsored two open meetings which were addressed by Dr Harlow Shapley, director of the Harvard College Observatory, and Dr W F G Swann, director of the Bartol Research Foundation

DR RAYMOND PEARL professor of biology in the School of Hygiene and Public Health of the Johns Hopkins University, delivered an address before the Washington Academy of Sciences on March 21 He spoke on Biology and Human Trends '

THREE lectures on Recent Progress in Astronomy" were given during March by Dr Samuel Alfred Mitchell, director of the Leander McCormick Observatory of the University of Virginia, at the Wagner Free Institute of Science, Philadelphia The titles of the separate lectures were "The Sun and Its Spectrum," "A Trip to the South Seas to Observe a Total Eclipse" and 'The Distances of the Stars "

PROFESSOR H RIES, of Cornell University, delivered the Orton Fellowship Lecture at the recent convention of the American Ceramic Society He spoke on 'Geology in Clay Research "

DR. CARL J P SKOTTSBERG, of Goteborg, Sweden, visiting professor at the Osborn Botanical Laboratory of Yale University, gave an illustrated lecture before the department of botany of Wellesley College on March 15 on "A Survey of Robinson Crusoe s Island "

THE Stuart McGuire lectures at the Medical College of Virginia will be given by Dr Gunnar Nystrom, professor of surgery, Uppsala University Sweden, on the evenings of April 29 and 30 The subjects of the lectures will be 'Embolism of the Arteries of the Extremities' and Pulmonary Embolism '

DR JOSEPH NEEDHAM, of the University of Cambridge, delivered two lectures on the Mead Swing Foundation at Oberlin College on March 27 and 28, on 'The Continuity of Chemical and Morphological Order'

THE psychologists of New York State, outside of the Metropolitan area, will hold their annual spring meetings at Colgate University, Hamilton, N Y, on April 12 and 13 Dr Fred S Keller is in charge of local arrangements Dr B F Skinner, of Harvard University, will be the speaker at the dinner meeting

THE dates for the May and June soirees of the Royal Society have been altered to Friday, May 3, and Friday, June 14

THE tenth congress of the International Society of Surgery will be held in Cairo from December 30, 1935, to January 4, 1936, under the presidency of Professor A von Eiselsberg, of Vienna

THE seventh International Congress on Industrial Accidents and Diseases will be held at Brussels, Belgium, from July 22 to 27 The American Committee of the congress is under the chairmanship of Dr Fred H Albee, New York, for the Section on Accidents and that of Dr Emery R Hayhurst, Columbus, Ohio, for Industrial Diseases

THE British Medical Association will hold its one hundred and third annual meeting in Melbourne, Australia, during the week beginning on September 9 under the presidency of Sir Richard Stawell, consulting physician to the Melbourne Hospital The *Journal* of the British Medical Association reports that the sectional sessions for scientific and clinical work will be held on Wednesday, Thursday and Friday, September 11, 12 and 13 The annual representative meeting for the transaction of medico-political business will take place in London at the association's house on Friday, July 19, and following days Members traveling to Australia through the United

States will sail for New York from Southampton on Saturday, July 27, if traveling by the Canadian route to San Francisco, they will sail for Montreal from Liverpool on July 26, or from Glasgow on July 27 The honorary local general secretary for this year's annual meeting is Dr J P Major, Medical Society Hall, East Melbourne, Victoria

THE trustees of the Surdna Foundation announce that Wesleyan University and ten welfare and religious institutions in Yonkers share in the first large distribution from the income from the fortune of the late John F Andrus The bequests amounted to $1,092,500, only a portion of the income of the foundation, which is said to be one of the most largely endowed charitable organizations in the world Wesleyan University receives $300 000 Mr Andrus who died on December 26, at the age of ninety three years, named the foundation by adopting the reversed spelling of his name

THE National Zoological Park will receive an allotment of $680,000 from PWA funds It is planned to build an addition to the bird house, a new elephant house and a house for small mammals, with special accommodations for apes It is also planned to provide a machine shop

THE private medical library of the late Dr Bailey K Ashford has been presented by his family to the School of Tropical Medicine at San Juan, Puerto Rico This library contains a large collection of books, periodicals and pamphlets, together with valuable historical data on sprue, anemia and hookworm, in which fields Dr Ashford had made notable contributions

THE University of Cambridge has accepted an offer from the Department of Scientific and Industrial Research of the sum of £2,300 for building and equipping the extension to the Low Temperature Research Station on its southern side It is to be used for scientific research and in the first instance for research in problems arising out of the preservation and handling of foodstuffs

DISCUSSION

WHAT DO WE MEAN BY A BACTERIAL LIFE CYCLE?

BACTERIOLOGISTS have for some years been engaged in a vigorous, and sometimes slightly acrimonious, discussion of the question whether bacteria do or do not exhibit phenomena associated with a life cycle" In a case of this kind, one always suspects that facts have been obscured by words Arguments are generally concerned with words and ideas Facts need not be argued about, they can be settled by observation

In the present case, the facts are reasonably clear Almost all bacteriologists will now acknowledge that many types of bacteria may at times exhibit morphological variants which differ rather widely from the forms most commonly observed in cultures These variants may be swollen or branched or spherical, when the normal form is a regular rod They may be larger than normal Very frequently they are much smaller than normal Furthermore, it is a well established fact that some of these bizarre cells are not involution forms'—if we mean by that term cells which are degenerating and necessarily doomed to perish Many such abnormal cells, particularly the tiny coccoid forms of rod shaped bacteria, have been shown to be viable and to reproduce the original type of organism If by a life cycle we mean the occurrence of cells having a form different from that commonly observed in the species but capable of reproduction, then many bacteria have a life cycle There is no essential difference between such a phenomenon and the familiar formation of endospores (except that the endospore has a special degree of resistance to unfavorable environmental conditions which many of the more recently described morphological variants lack)

Those who contend that bacteria lack a life cycle define the term more strictly They consider that a "life cycle" must involve a certain inevitable and repetitive sequence of stages In this sense they maintain that the bacteria do not possess a life cycle If one transfers a culture in the phase of logarithmic growth to a fresh medium of the same kind, experience shows us that the form and size of the cells remain strikingly constant, and we have no reason to doubt that such a process can be continued indefinitely A "cycle," according to Murray, means "a recurrent period (of events, phenomena, etc) " Those who object to the life cycle theory may rightly maintain that such experiments exclude the existence of recurrent periods of varying morphology, due to some inherent tendency of the bacterial cells

It is precisely, however, in this tacit assumption that a life cycle must be free from any environmental influence that there lies another dangerous pitfall of definition If we allow that repetitive changes may directly result from environmental conditions and yet may constitute a life cycle, the balance of argument swings in favor of the "cyclists" If, instead of transferring a colon bacillus from one culture tube to another in the logarithmic phase of growth, we leave it

in the original medium for a longer period and then transfer it, a very definite series of repetitive events may be observed The cells when first transferred to a new medium are small in size and exhibit certain quantitative physiological characteristics Then for a certain period the cells become larger and physiologically far more active The size may increase tenfold and the activity per cell fifty fold Later, both size and activity decrease again to their original figures Under certain conditions, bizarre and coccoid and perhaps very minute or "filterable" forms may occur On transfer to a fresh medium, the "cycle" repeats itself with perfect precision

It must be freely granted that such a cycle is related to the effect of environment and not to any inevitable inherent tendency of a single cell, but I suspect that the same thing is true of all life cycles throughout the living world The zoologist can cultivate protozoa, the botanist can cultivate molds, for an indefinite period by sufficiently rapid transfer to fresh substrates, without the appearance of cysts or spores or any other departure from the more usual morphological picture presented by the species All that appears in such a case, if the medium be favorable, is the ordinary "life cycle" of binary fission The phenomenon of endomixis does not present any real exception, since it does not alter the form or physiological properties of cells in any cyclical way In the multicellular organism life cycles are apparently inherent simply because the organisms *are* multicellular and because the multicellular life produces a change in the environment of the individual cell more or less comparable to that produced in an old culture of bacteria The germ cells exhibit no life cycles from generation to generation It is true that in a metazoon there is a specialization of cell function associated with division and differentiation, but this is clearly degenerative rather than cyclical, since it is normally irreversible Even specialized somatic cells when cultivated by Carrel *in vitro* show no life cycles after many years of observation

May we not assume, then, that with all living cells, the "life cycle" so far as the individual cell is concerned—is a cycle of simple binary fission Other phenomena involving change in cell morphology and physiology of a cyclical nature are responses to changing environmental conditions and not the result of any inherent time mechanism If a unicellular organism shows a definite series of morphological and physiological alterations in response to certain changes in environment which are likely to occur with reasonable frequency in its natural life we may call it a "life cycle" if we wish or we may call it something else In any case, this is the only kind of life cycle (other than binary fission) which can occur in unicellular and relatively simple multicellular forms In this sense, the bacteria have life cycles When we find a more complex and more regular life cycle in the higher plants and animals (relatively independent of external environment), it is because the interrelationships of the complex organism produce a cyclical change in the internal environment which is comparable with the change which takes place in a bacterial culture and which affects the individual body cell very much as the cultural environment affects the unicellular organism

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THE PRESS SERVICE AT THE PITTSBURGH MEETING

THE baffling problem of handling the paper winning the $1,000 prize appears at last to have been successfully solved At Pittsburgh the announcement of the prize winning paper was made at a conference of press representatives called for 9 A M at which a carefully prepared, clear and thoroughly intelligible résumé of the paper and a biographical sketch of the author, were handed each one present, and arrangements were made for answering any questions that might be asked The complete paper was also available The release was for morning papers on the following day Ample time was thus afforded the press representatives for studying the paper and for securing interviews on the subject matter

The proportion of the total number of papers sent in advance to the Press Service was slightly less than at the preceding Boston meeting There were 1,806 papers (including demonstrations, etc) listed in the program, of which 396 (20 2 per cent) were received in advance

If the 60 papers that were not received until after the meeting (partly because of having been mailed with insufficient postage) are added to the number sent in, and the 109 mathematical papers, which can not be handled successfully in the usual routine, are subtracted, there were 1 697 papers presented, of which 462 (23 5 per cent) were received

The number of papers listed and received, arranged by groups, was as shown in Table I

This year each paper as soon as it was received was carded by author By the use of this card catalogue the press representatives were able to find out at once whether or not a copy of any given paper was available, and all the essential information regarding the papers at hand This card index proved to be exceedingly useful, and constant reference was made to it throughout the meeting

For press purposes it is essential that information regarding the proceedings day by day shall be avail-

TABLE I

Section or Group	Papers	
	Listed	Received
Exhibits and Demonstrations	87	1
General Sessions and Committees	25	10
Joint Sessions		14
Mathematics (A)	109	0
Physics (B)	149	37
Chemistry (C)	20	3
Astronomy (D)	21	7
Geology and Geography (E)	32	24
Zoological Sciences (F)	466	63
Botanical Sciences (G)	292	154
Zoology and Botany (F and G)	118	18
Anthropology (H)	55	21
Psychology (I)	42	23
Social and Economic Sciences (K)	40	12
Historical and Philological Sciences (L)	6	1
Engineering (M)	3	1
Medical Sciences (N)	48	26
Agriculture (O)	246	29
Education (Q)	33	16
Science in general (X)	14	2
Totals	1,806	462[1]

[1] Compare with table in SCIENCE, 79: 141, 1934.

able at a glance. Beginning at the St. Louis meeting the pages from two programs will be cut and pasted together in such a way as to show the proceedings of the entire meeting chronologically, with the available papers checked, and these strips will be placed on a bulletin board.

During the meeting two typists were present in the press room for the purpose of making copies, in duplicate, of those papers for which there was a special demand. This plan has been adopted at previous meetings and has worked very well. The ideal procedure, of course, would be to have all the material mimeographed, or at least to have at hand mimeographed copies of from 50 to 100 of the papers most likely to be of interest to the press. But the expense involved is prohibitive.

At the Pittsburgh meeting there were in attendance no less than sixteen press representatives from other cities, ten of whom were members of the National Association of Science Writers, and ten from the Pittsburgh papers and local offices of press associations.

Such marked attention on the part of the press places upon the association a grave responsibility. The meetings of the association form the chief medium through which the general public learns of the advance of science as a whole. We must make every endeavor for our own good to increase largely the proportion of papers made available to the press, and to see to it that all vice-presidential addresses and general sessions papers are submitted as long in advance as possible.

We must all work together in order that the press may have an abundance of suitable material to present to the public. Let us do all we can to assist the press in its effort to give the people an adequate and accurate picture of the progress of science as it is brought out at our meetings.

AUSTIN H. CLARK,
Director

THE COST OF GERMAN SCIENTIFIC JOURNALS

PUBLISHED protests on the unreasonably high price of subscriptions to German technical periodicals are not effective. The present high price is not so much a matter of exchange conditions, although this is a factor, as it is the abnormally high initial price demanded by the publishers, amounting to extortion. Although after five years of depression, we are maintaining our library budget essentially unimpaired, I have directed that our subscriptions to sixteen German botanical periodicals be cancelled immediately. This has been done for the reason that subscriptions amounting to five to eight times as much as the rates charged for similar serials published elsewhere are not justified under any conditions. It is admitted that in a reference library broken sets of periodicals are regrettable, but when the cost per volume is so exorbitant, as in this case with those now discontinued, this is unavoidable. If other American institutions would do likewise, such action might be effective in reducing the present plethora of abnormally high-priced German periodicals.

E. D. MERRILL, *Director*
THE NEW YORK BOTANICAL GARDEN

GAUSS AND THE FRENCH ACADEMY OF SCIENCE

IN his "A Short Account of the History of Mathematics," 5th edition, p. 448 (1912), Ball makes the statement that Gauss had submitted a part of his famous Disquisitiones Arithmeticae to the French Academy, which the latter rejected in a manner which must have been humiliating for Gauss.

A careful examination of the writings and biographical material of Gauss does not show a trace for such an occurrence. Professor Brendel, of the University of Freiburg, who is in charge of the Gauss archive, does not know of anything that might point to such a rejection.

Moreover, according to an official transcript sent to the writer by Professor Picard, permanent secretary of the French Academy of Science, there is not

the slightest evidence that the academy ever did such a thing as Ball claims.

On the contrary, the academy bestowed upon Gauss at an early age the highest academic honors.

The record of the French Academy is clear and all in favor of Gauss.

ARNOLD EMCH

LEEUWENHOEK LETTERS

SOME American libraries and collections may possess letters written by and to Antony van Leeuwenhoek; and photographic copies of such letters are being sought by the Royal Academy of Sciences of Amsterdam, which is preparing a critical edition of Leeuwenhoek's correspondence. A list covering about 100 missing items is published in the appeal of Dr. G. van Rijnberk in *Nederl. Tijdsch. v. Geneeskunde,* December 1, 1934.

Readers knowing of such letters in America are asked to communicate the information to Dr. van Rijnberk, or to the undersigned.

BARNETT COHEN

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN EXTRACTOR USING A SOLUTION OF VOLATILE AND NON-VOLATILE PHASES

UNLIKE most extractors which are limited in their use to volatile solvents, a simple device is suggested which extracts with a solution consisting of one volatile phase and one or more non-volatile phases. Its success is due to the fact that if the vapor-disengagement area is sufficiently reduced, entrained solution is carried with the vapor.

A flask (Fig. 1) is filled with solution to a single

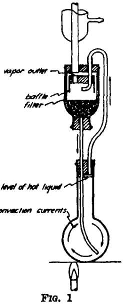

FIG. 1

small outlet. When boiled, vapor and solution are carried up to the filter. A baffle separates the vapor from the liquid. The return of the liquid through the filter to the bottom of the flask is facilitated by convection currents caused by heating the flask on one side.

The process is continuous and the velocity is controlled entirely by the amount of heat supplied. Larger quantities of liquid may be delivered to the filter than by condensate devices, since only a small part of the liquid has to be vaporized. This device may also extract by condensate alone by simply lowering the level of the liquid in the flask, thus increasing the disengagement area.

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A SIMPLE METHOD FOR OBSERVATION OF CIRCULATION IN THE WEB OF THE FROG'S FOOT

CIRCULATION of blood in the web of the frog's foot may be observed very clearly if the spread foot is strapped over the hole in the frog board with a strip of wet Cellophane secured to the board by thumb tacks (Fig. 1). The preparation is more quickly made than

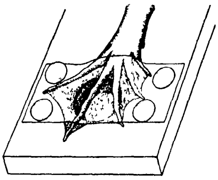

FIG. 1

are preparations in which the foot is spread by tying the toes, and is superior in a number of other respects. Since the animal is relatively comfortable, movements of the foot are reduced to a minimum. The web may be kept moist by occasional moistening of the Cellophane, or by introducing a film of water between the web and the Cellophane. Since the web is relatively flat, a good picture may be obtained with the 4 as well as with the 16 millimeter objective, without the use of

a cover glass. Preparations made thus may be kept under observation for a long time with little attention, except occasional moistening. With animals wrapped in the usual manner in wet cloth, preparations have been used in our laboratory for periods exceeding two hours. The method is so simple and obvious, the writer suspects that others must also have thought of it; but he makes bold to pass it on to those who may not have done so.

HORACE J. CHILD

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THE DESIRABILITY OF HOMOZYGOUS MICE IN NUTRITION EXPERIMENTS

IT is pretty generally conceded that the Wistar strain of rats is preferable in nutrition experiments, so that the animals will be homozygous and also of the same strain in coordinating the work of different investigators. Mice are used mainly by bacteriologists, cancer workers and geneticists, but in the assay of hormones and the determination of the nutritive value of pure chemical substances it is sometimes possible to save thousands of dollars by using mice instead of rats. Yet no standard strain of mice has been generally adopted. Since, however, a number of papers have appeared, using the Bagg strain of homozygous albino mice (Cold Spring Harbor Station of the Carnegie Institution), it seems probable that Table 1, showing the growth rate (mean body weight and standard deviation) of Bagg albinos, quoted from our paper in "Science Reports of Tohoku Imperial University," April, 1935, should be of interest. A paper on the growth and chemical composition of the brain of Bagg albinos by Hideo Endo will also appear in the same reports at a later date. Although the mouse grows at a slower rate we have been able to produce marked rickets in the mouse on the same diet that produced rickets in the rat.

TABLE 1

BODY WEIGHTS AND STANDARD DEVIATIONS IN GRAMS

Day of age	Males: Mean weight	Males: S.D.	Females: Mean weight	Females: S.D.
1	1.313	.200	1.300	.200
2	1.506	.245	1.515	.200
3	1.754	.283	1.770	.316
4	2.090	.374	2.160	.316
5	2.452	.458	2.570	.486
6	2.880	.548	3.020	.557
7	3.300	.574	3.470	.781
8	3.770	.663	3.970	.761
9	4.205	.768	4.425	.894
10	4.670	.774	4.920	.974
11	5.020	.948	5.320	1.118
12	5.390	1.128	5.630	1.288
13	5.775	1.162	6.040	1.331
14	6.100	1.162	6.410	1.414
15	6.407	1.200	6.690	1.536
16	6.570	1.049	6.920	1.477
17	6.780	1.183	7.040	1.550
18	6.850	1.483	7.170	1.517
19	6.960	1.442	7.240	1.637
20	7.130	1.466	7.410	1.674
21	7.330	1.449	7.720	1.612
22	7.669	1.634	7.950	1.761
29	9.480	1.803	9.870	1.897
36	12.360	2.345	12.500	2.290
43	14.740	2.236	14.470	2.190
50	16 740	2 510	15.610	2.388
57	18.540	2.934	16.640	2.367

J. F. MCCLENDON
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SPECIAL ARTICLES

COMPARISON OF X-RAY AND GAMMA RAY DOSAGE[1]

NEED for a suitable correlation between x-ray and radium dosage had led us to extend our recent studies in the ionization produced in liquids by x-rays.[2] This note is for the purpose of giving briefly the results of some absolute measurements of the ionization produced in carbon bisulfide by gamma rays. Air ionization methods, while satisfactory for dosage measurements up to 200 kv, may be rendered ambiguous for higher frequency radiations because of lack of radiation equilibrium. A comparison of the physiological effects of different radiations ideally should be based on comparison of the numbers of ions produced in the tissue. In practice, one can make relative measurements in dielectric liquids nearly equivalent in density and atomic number to living tissue.

For gamma rays carbon disulfide is sufficiently near tissue (or wax) in atomic number and density to be considered equivalent. A combination of the two materials will, therefore, give an effectively homogeneous medium in which there will be radiation equilibrium and uniform mass absorption. Measurements were made of the gamma ray absorption in a layer 1 mm thick at the incident surface of a 25 cm cubical wax phantom. The ionization chamber con-

[1] Publication approved by the director of the National Bureau of Standards of the U. S. Department of Commerce.

[2] F. L. Mohler and L. S. Taylor, *Bureau of Standards Jour. Res.*, 13: 659, 1934.

sisted of two fine aluminum grids separated by a quartz disk 1 mm thick which had a 19 mm hole in the center This was immersed in the liquid contained in a thin shallow glass dish which was in turn set into the wax surface Fields up to 70,000 volts per cm showed that the 'effective volume" was given by the geometric volume between the grids for separations from 0 5 to 2 5 mm The radium, contained in a glass tube 8 mm long and 27 mm thick, was supported about 16 mm above the liquid surface and filtered with 75 mm brass plus 2 mm of bakelite Applying approximate corrections for distance and filtration, the ionization produced by 1 mg of radium filtered with 1 mm of lead and at a distance of 1 cm from the wax surface was found to be 9400 e s u /cm³/hr Assuming that the gamma ray absorption is proportional to the density of the liquid or gas and that the energy per ion pair is 24 electron volts as compared with 33 for air,[2] the above ionization would correspond to 6 9 roentgens per hour Measurements made with the cell removed from the wax phantom showed the ionization to be almost entirely due to primary radiation Similar measurements of the ionization produced in a mixture of CS_2 and ligroin (density = 1) by x rays of equal doses generated at 120 kv and filtered with about 2 mm of copper gave an increase of about 30 per cent due to back scattering as compared with 38 per cent using a thimble ionization chamber calibrated in the usual manner Since it is impossible to calibrate a thimble chamber for the radiation quality produced in the back scattering, the disagreement between the air and liquid measurements is not unexpected Measurements made as here described in suitable liquids are independent of the radiation quality and hence the chambers need no calibration While the above method seems well adapted to evaluating radium dosage in roentgens, the preliminary values given above are being investigated further in an endeavor to minimize the corrections

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TRANSMISSION OF THE VIRUS OF POLIOMYELITIS TO MICE

THE purpose of this paper is to report the successful propagation and serial transmission of the virus of poliomyelitis in mice The mouse was chosen for this study for reasons described by one of us [1]

Three series of mice were exposed to short repeated doses of x ray and then inoculated, both intracerebrally and intraperitoneally, with suspensions of the spinal cords of monkeys, who had succumbed to poliomyelitis In the first series, the animals were irradiated daily for 10 days prior to inoculation On the second day after inoculation, x ray treatments were begun again and were given daily for 8 days On the eleventh day after injection, all the mice showed ruffled hair, sluggishness and dragged their hind legs, either on that day or the following one Four of the animals died on the eleventh day one on the twelfth, three on the sixteenth and three on the seventeenth day after inoculation Two were autopsied on the eleventh and twelfth days A suspension of their brains, when inoculated into mice and a monkey, failed to produce reaction

In the second series, on the eleventh and twelfth day after inoculation they showed ruffled hair, ataxia, sluggishness and dragged their hind limbs The animals in this group died or were killed A suspension of their brains produced similar symptoms after an incubation period of from 14 to 24 days, in 5 out of 8 untreated mice which were injected A monkey inoculated with this suspension showed a rise in temperature Serial passages were carried out, using mouse brains as the inoculum Thus far, the virus has been maintained through 17 generations With succeeding passages, the animal response became more definite and the incubation period became shorter so that by the fifth passage, a 10 per cent suspension brought down all the animals after an incubation period of 3 days Using more concentrated brain suspensions, the incubation period may be shortened to 2 days, and with diluted suspensions it may be lengthened to 7 days By successive transfer, the infectivity of the virus has been increased, so that by the twelfth passage it was infectious in a dilution of 1 1000

In the third group, 4 out of 7 mice inoculated with the brain material of irradiated mice that had succumbed, showed symptoms similar to those of the mice in the second series Fifty control animals that were exposed to x ray, but were not injected, developed no symptoms, although some of them received twice as many x ray treatments as did the inoculated mice When the filtrate of the suspension of the brains of 2 of the animals that came down with the aforementioned symptoms was injected into 8 untreated mice, 7 of them showed the usual hyperirritability, ataxia, sluggishness, ruffled hair and humped back A monkey, inoculated with this filtrate ran a typical course of poliomyelitis, with a characteristic histopathological picture in the cord In the next passage, all twelve mice injected showed symptoms after an incubation period of 3 to 4 days This series has undergone 14 transfers with changes of infectivity and incubation period, similar to those of the preceding series

[1] M Brodie, *Proc Soc Exp Biol and Med*, March, 1935

Now that the virus is fixed, the clinical picture in the mouse is quite acute It begins with irritability, jumpiness, ruffled hair and goes on to ataxia, humped back, convulsions, circular movements, twisting of the head and sometimes ptosis of the eyelids The animals usually die within a few hours after the onset of symptoms The mice also can be infected by the intranasal route with an incubation period of 5 to 6 days

In contradiction to the lesions in human and monkey poliomyelitis, those in the mice occur mainly in the brain and meninges, rather than in the spinal cord In the pia arachnoid and its projections there is an extensive mononuclear infiltration mostly perivascular, which is most marked over the brain In the spinal cord and brain stem, there is an occasional perivascular collar and some hemorrhagic foci the cerebellum shows no changes, while the cerebrum shows perivascular collars, areas of hemorrhage focal areas of necrosis and glia reaction with a rare polymorphonuclear leucocyte

As in the monkey, the virus appears to be in the cerebro spinal axis only It is present in the cerebrum, brain stem, cord and cerebellum The greatest concentration of the virus is in the cerebrum, which is in keeping with the distribution of the histopathological changes

The following findings indicate that we are dealing with poliomyelitis and not a spontaneous virus infection of mice

(1) The mouse virus was transferred to 13 monkeys and was infective in a dilution of 1 5000 A transfer of the virus from one of these monkeys to another monkey and back again to mice was successful A complete histopathological study of the cords of four of these monkeys showed changes typical of acute anterior poliomyelitis

(2) The serums of convalescent humans and monkeys, of actively immunized children and the serum of a so called normal adult, containing anti viral substance, neutralized this virus Normal monkey serums failed to do so Human convalescent serum protected a monkey against the virus and neutralized suspensions of cords removed from monkeys infected with the mouse virus Upon diluting the serums, it was possible to obtain an end point in keeping with similar tests carried out in monkeys

(3) Poliomyelitis in mice differs both clinically and histopathologically from the spontaneous mouse encephalomyelitis described by Theiler,[2] who kindly sent us some of his virus The infectivity of the latter is irregular and its injection is followed by an incubation period of from 3 to 4 weeks This spontaneous disease in mice runs a more protracted course with slowly progressing paralysis The distribution of the virus in the cerebrospinal axis and the histopathological picture are also different from that of the mouse poliomyelitis

One of us[3] has described the immunization of monkeys and children against poliomyelitis However, the incidence of the disease is so low and the preparation of the vaccine so expensive that its application is limited It has been found that not only convalescents, but also many normal children, even in the susceptible age group, have antiviral substances in their blood Vaccination should be limited to those without any antibody At present a test for antibody can be carried out only in monkeys Results of preliminary experiments, in that they check with those of identical tests in the monkey, indicate that such a test can be carried out in the mouse Thus it may be possible to use mice instead of monkeys to determine those who require vaccination and the results of the immunization

In the mouse, the disease differs from that in the monkey, since in the smaller animal it is a meningo encephalomyelitis The virus has lost its affinity for nerve cells for it affects mainly the connective tissue elements of the central nervous system

We believe that the outcome of the foregoing studies show that the virus of poliomyelitis has been transmitted successfully through mice by serial passage

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[2] M. Theiler, SCIENCE, 80 122, 1934

[3] M Brodie *Jour Immun* 28 1, 1935, *Am Jour Pub Health*, 25 1, 1933

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DIRAC, P A M *The Principles of Quantum Mechanics* Second edition Pp xi + 300 Oxford University Press $6 00

LIEBEN, FRITZ *Geschichte der Physiologischen Chemie* Pp x + 743 Franz Deuticke, Leipzig M 23

MARSH, J S *Principles of Phase Diagrams* Pp xv + 193 180 figures McGraw Hill $3 00

MORROW, CLARENCE A *Biochemical Laboratory Methods for Students of the Biological Sciences* Revised and rewritten by WILLIAM M SANDSTROM Pp xv + 319 37 figures Wiley $3 75

POMFRET, JOHN E *The Geographic Pattern of Mankind* Pp xv + 428 15 figures 21 plates Appleton Century $4 00

SCIENCE

VOL. 81 FRIDAY, APRIL 5, 1935 No. 2101

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

FACING THE EROSION PROBLEM[1]

By H. H. BENNETT

DIRECTOR, SOIL EROSION SERVICE, U. S. DEPARTMENT OF THE INTERIOR

THE productive agricultural lands of the United States are being seriously impaired and even destroyed on a vast scale. The plant nutrients and the soil body itself are being removed from fields and over-grazed ranges at an ever-increasing rate under existing methods of unwise land usage, with the effect not only of impoverishing and even destroying the uplands but of covering fertile lower slopes and productive alluvial plains with poor subsoil material washed out of the hills. Moreover, the products of erosion are filling stream channels and costly reservoirs; increased runoff from soil-stripped, gully-riddled slopes is increasing the hazard of floods; and many streams muddied with silt and colloidal clay have been deserted by valuable species of fish. This irreparable damage is increasing at an accelerated rate. Centuries would be required to build back the soil swept out of the fields and overgrazed pastures of the nation by this process that continues with every rain heavy enough to cause water to run downhill. We have been maintaining our agricultural production at the expense of the substance of the land.

The average citizen is unacquainted with the gigantic proportions of this devastating agency of uncontrolled erosion by wind and water. Educators, business men and statesmen, even our specialists—many of our engineers and agricultural experts—do not yet realize that more than 75 per cent. of the country consists of sloping land, all of which is subject to erosion in some degree where used for clean-tilled crops or where subjected to unwise grazing. Nor is it generally known that the average depth of the more productive topsoil of these erosive lands is only about 7 or 8 inches, or that this thin covering, representing the farmer's principal capital, is being swept

[1] Presented before Section O, American Association for the Advancement of Science, Pittsburgh, Pa., December 28, 1934.

completely away at rates ranging generally from about 3 to 60 or 75 years, depending on the kind of soil, the declivity of the land, the rainfall and the type of agriculture.

A thriving agriculture is the basis of national prosperity. When the rich, humus-charged surface layer is stripped off the land, it can not be restored, and without this productive covering agriculture generally can not be prosperous, whether prices are up or down. The world is strewn with ruins of once flourishing civilizations whose basis of continuance has been destroyed by erosion. No greater problem than the control of erosion confronts the nation to-day. The problem is national in character and scope. The injurious effects touch directly or indirectly the interest of every citizen.

WHITE MAN'S METHOD OF LAND USE

What has happened in this country since the white man took over from the Indians the vast expanse of virgin soil covered with far-flung forests of valuable timber or clothed with luxuriant prairie grasses, is a tragic story. Faster probably, than any nation or race we have been impoverishing and destroying our indispensable agricultural lands. Other parts of the world, such as the highlands about Antioch, Syria, have been devastated by this wasteful process and the people have deserted the skeletonized areas, but their lands were used for thousands of years. We have used ours only a little more than 250 years, most of it for less than 75 years. In this short time we have succeeded in putting through a gigantic undertaking of land degradation, and this without stopping to think seriously of what we have been doing. Only recently have we begun to measure the impoverishing effects of erosion, and even now we have scarcely begun to apply the scrutiny of research to this menacing problem.

A short time ago it was estimated, on the basis of existing surveys, that at least 35 million acres of formerly cultivated land had been essentially destroyed by erosion. Now, on the basis of a nation-wide reconnaissance erosion survey, recently completed by the Soil Erosion Service, it is found that the area of formerly cultivated land largely essentially ruined amounts to not less than 100 million acres. This is the equivalent of 625,000 farms of 160 acres each, an area nearly equal to the combined extent of Ohio, Illinois, Maryland and North Carolina. Isolated fields and small parcels of ground between gullies and soil-denuded slopes can still be cultivated on a patch-farming basis, but fully half of the area is physically unfit for cultivation, chiefly because of severe gullying, with the other half about as bad.

In addition, approximately 125 million acres of the land now in cultivation have lost all or the greater part of the topsoil, and as the result these denuded lands are from about 2 to 10 times less productive than was the virgin soil.[2] They are not only less productive, but they are more difficult and expensive to plow and rainwater flows over the exposed impervious clay more rapidly to increase the rate of erosion, the rate of silting of stream channels and reservoirs and the volume of floods.

Thus we have permitted tens of thousands of farmers to become subsoil farmers, which means generally something very closely related to bankrupt farming on bankrupt land. Moreover, the virtual ruin of the soil is essentially of a permanent character, jeopardizing the well-being of generations to follow.

THE WAY OUT

There is one way and only one way out of this menacing national situation of land depletion by erosion, and that is to put through as speedily as possible a properly coordinated, complete and adaptable soil conservation program on all the remaining areas of good land needing protection. Such a program calls for treatment of the land in accordance with the specific needs and adaptabilities of the many different kinds of land. Any other method of approach will merely postpone the accomplishment of those things that must be carried through if this is not to be probably the greatest nation of poor subsoil farming of all the earth's history. Postponement of this inescapable task simply means a more difficult and costly job ahead.

We have been fighting erosion in some parts of the country for more than 75 years, notably in the southeastern Piedmont region, but we have not overcome the enemy. Even in this older agricultural section the evil has been spreading much faster than the application of efficient corrective measures. Our attack has been largely one in which a single implement was employed, that is, hillside ditching and hillside terracing for slowing down the runoff. On gently sloping land this single-track method of combat has accomplished much good, but on a very large area of steeply sloping, highly erosive soil the practice has, in the long run, done more harm than good. For example, the recently completed nation-wide erosion survey shows that considerably more than two million acres of terraced land in the state of Georgia alone have been essentially destroyed for further practical crop use. The building of terraces where they were not applicable, or failure to build them correctly and properly maintain them, hastened the permanent downfall of these formerly fertile slopes.

[2] H. H. Bennett, *The Geographical Review*, V. XXIII, No. 3, p. 431, July, 1933.

In spite of the obvious physical impossibility of controlling erosion except by making extensive use of vegetation in our control measures, many specialists to day are boldly asserting that an engineering method of attack—one employing a single implement of combat—is the complete and final answer to the erosion problem Since erosion begins wherever water accumulates in sufficient quantity to flow down hill across unprotected areas, the only possible purely engineering method for actually controlling an agency of this kind, if there is any truth in mathematics, would be to build extensive walls, as those found in parts of the Mediterranean Basin, with which it would be possible to cultivate the land on the level Labor conditions and topographic and other physical characteristics of the land utterly preclude this method of control in America, for the present at any rate Such laborious procedure is not essential to success, there are other methods—effective, practical methods, as those now being used with a high degree of success on the demonstrational areas of the Soil Erosion Service These methods will be referred to later

Need of Education

A depressing aspect of the whole erosion problem is that we have assumed the country has enough land to withstand the most violent misuse Many have looked upon soil wastage by accelerated erosion as a process over which man has no control, and some have stubbornly refused to recognize any distinction between the exceedingly slow *geologic norm of erosion* (generally harmless) and the devastating *accelerated erosion* brought about through the instrumentality of man With reckless prodigality, all kinds of land have been used for a great variety of crops, as if all of it, good and bad, steep and level, were equally adapted to these diverse uses

The average American has no particular love for the land and little understanding of it The explanation is fairly simple Colonists pouring in from great reservoirs of population in Europe began a westward march across the continent under conditions that led them to believe the American continent was endowed with limitless and inexhaustible supplies of land, forest and game Now that our frontiers have disappeared in the Pacific, and are reappearing in the East and West, we are beginning to appraise the gigantic waste that went with that rapid occupation of the country, which we have liked to boast of as the "conquest of America" Vast stretches of forest are gone, the buffalo have been killed, some species of game birds have been exterminated, and we find hundreds of millions of erosion-made gullies and tens of millions of acres of erosion exposed clay subsoil where there was not a single gully of this kind nor one acre of man induced, freshly exposed subsoil when the country was taken over by the white man

It is true that erosion had been going on in many parts of the sparsely vegetated western regions, where great canyons had been dug out, before the advent of the white man But we are not concerned with that phase of erosion, nor with the exceedingly slow process of normal or geological erosion, such as is responsible for the building up of fertile stream bottoms throughout millions of years It should be perfectly understood that the accelerated erosion we are considering is the product of excessive runoff caused by the reduction of the absorptive capacity of sloping land as the result of removing the stabilizing cover of vegetation and the cultivation and grazing of the land since the occupation of America by the white man

Absorption, runoff and erosion are interdependent processes, and for all practical purposes may be considered as a single 3 phase physical agency These processes—rather, this agency is profoundly influenced by slope, climate, soil, density of the cover of vegetation and the use made of the land When the normal vegetative cover is removed the soil is laid bare to the full destroying effects of violently rushing rainwater and hurtling wind The process of plowing vitiates or tears down the effective porosity of the virgin soil, closing conduits made by earthworms and plant roots, and disrupting the porosity that goes with the natural granular or loam like structure of the soil With further cultivation the humus content of the soil—the sponge like binding material—is dissipated by processes of decomposition and oxidation In this way man effaces within a few brief years what nature has taken centuries, even thousands of years, to build If we observe some of the lessons of nature, making liberal use of vegetation in various adaptable cropping practices and eliminating the steeper slopes from cultivation, these same areas can be conserved almost indefinitely But we have not been thinking along these lines, and upon a foundation of misconception about the extent and durability of our good farm lands, plus a vast amount of stark ignorance concerning erosional processes and rates, and the dire effects of these activities on the productivity of the land, we have built a far reaching system of farm tenancy which still further adds to the sinister import of this ignorance and indifference with respect to how the land is used and wasted

Runoff and Erosion from Different Soils Undergoing Various Cultural Treatments

Quantitative measurements of soil and water losses from comparable areas undergoing different cropping treatments will be given for but one important agricultural soil.

Taking measurements made at the Bethany, Missouri, erosion station on one of the most extensive soils in the rolling sections of the corn belt (the *Shelby silt loam* and its very close relative *Shelby loam*), it has been shown that from about the average regional slope (8 per cent), devoted continuously to corn, the average annual soil loss from a representative slope cross section of 73 feet has amounted to approximately 60 tons per acre along with a loss of 27 per cent of the total precipitation as immediate runoff. As against this, the corresponding losses from exactly the same kind of land, receiving the same rainfall, seeded to thick growing, protective crops, have been very much less. Under alfalfa the loss of soil has been at the rate of only .21 of a ton per acre annually, along with a runoff of only 3.41 per cent of the total precipitation; under timothy the corresponding losses have been at the rate of .32 of a ton of soil an acre and 7.71 per cent of the precipitation. In other words—and this is of tremendous significance in connection with the whole national plan of flood control, land utilization, prevention of silting and conservation of our indispensable agricultural domain—alfalfa has been 289 times and grass 190 times more effective than corn in holding soil on the slopes where it belongs. The respective efficiencies of the two crops in relation to rainfall retention, as compared with corn, have been approximately 8 and 3½ times as great.

For the same period the same type of land kept bare of all vegetation has lost an average of 112 tons of soil per acre per annum, or more than 500 times as much as was lost from fields devoted to alfalfa. From fields where a 4-year rotation of corn, wheat and clover was practiced—fields having exactly the same soil and slope and subjected to the same rainfall—the soil loss has proceeded at the average rate of only 9.9 tons an acre annually, while the water loss has been at the rate of 11 per cent of the precipitation, showing that a good crop rotation is a highly effective method for minimizing both runoff and erosion.

These measurements indicate that under continuous corn production, on 8 per cent slopes of this region, about 20 years would be required to strip off the top layer of productive soil, down to stiff, impervious clay that bakes in dry weather and sheds the rainfall at a terrific rate. On 4 per cent slopes, approximately 30 years would be required to complete this job of surface denudation. Under grass something like 3,900 years would be required to remove the topsoil from 8 per cent slopes of *Shelby* soil.

The *Shelby* soils, together with their closely allied types, constitute the principal kind of land within an area of about 11 million acres, in northern Missouri, southern Iowa, southeastern Nebraska and northeastern Kansas. Our surveys indicate that of this area about 4,500,000 acres already have suffered severely from sheet washing and that 500,000 acres have been essentially ruined by gullying following sheet erosion.[3]

Damage of Valley Lands by Overwash of Erosional Debris

In numerous localities deposition of the products of erosion has had a disastrous effect with respect to channel choking, filling of reservoirs and covering of formerly good agricultural land with inferior soil material. Soil surveys in the Piedmont section of South Carolina had, prior to about 1930, classed 72 per cent of all the alluvial land mapped within that area as *Meadow*—that is, as wet to swampy stream bottom so changed from the original condition by overwash that it was impossible to classify it correctly under definite soil type designations.[4] The stream channels had been choked with erosional debris, overflows were more frequent and most of the land, though formerly cultivated, had been abandoned, and supported a growth of willow, alder, sweet gum, smilax, blackberry, rushes and cattail. This is about the condition that now characterizes most of the alluvial soil of the entire Piedmont region from Virginia southward.

Soil types are being mapped in various parts of the country which represent recent wash from cultivated uplands. These soils generally are much lighter colored than the old alluvium which they have covered, and they are more diverse with respect to texture of material. Generally they are considerably lower in content of organic matter, especially where erosion of the uplands has proceeded to such an extent that relatively poor subsoil material is being deposited over the surface of the bottom lands. In this way some of these recently formed alluvial soils, that is, soils formed since the beginning of agriculture, represent an approximation of inverted upland soils transferred to the alluvial plains below.

Usually the line separating the buried pre-agricultural alluvial soil from that formed since the beginning of cultivation of the uplands is so sharp that it can be easily photographed. In many instances the depth of the soil belonging to the latter stage of deposition exceeds the entire depth of the old alluvium from its surface down to the bed of the stream channel or even to bedrock in some instances. Characteristically the texture of the older material is distinctly finer than that of the recent

[3] H. H. Bennett, pp. 474–488 *Transactions American Geophysical Union*, Nat'l Research Council, 15th annual meeting, 1934, Washington.

[4] H. H. Bennett, South Carolina teacher training program (mimeographed), p. 20, Bureau of Chemistry and Soils, U. S. Dept. of Agriculture, 1932.

deposits, darker colored and much more uniform These facts, coupled with the fact that the covering of recent material often is as deep as and in some places deeper than that below, show conclusively that the characteristic suspension of the flood waters of the preagricultural stage was entirely different from that of the latter stage Other profile characteristics, considered in connection with the obviously much longer period involved with deposition of the pre agricultural material, show conclusively that sedimentation before the coming of the white man was from flood waters of comparatively slow velocity Study of the profiles of these alluvial deposits in the older agricultural areas affords abundant evidence that floods along most of the streams within areas of rolling topography, as well as silting, have increased greatly since the beginning of agriculture

SEDIMENTATION OF RESERVOIRS

Many of the storage reservoirs of the southern Piedmont have been filled to the top of the dam within less than thirty years One major reservoir on the Colorado River in Texas was largely filled in the course of about five years The Elephant Butte Reservoir in New Mexico, estimated in the beginning to have a life of 220 years at the present rate of silting probably will be useless in times of protracted drought at the end of about 60 years The Harding Reservoir in California filled as the result of one rainy period following a serious fire on the watershed

Between 1922 and 1934 the watershed of the Gibraltar Reservoir (200 square miles), near Santa Barbara, California (the dam of which was completed in 1920), has, according to records recently made available, suffered from 11 major fires, which have progressively increased the area burned to 87 per cent of the total watershed Between 1920 and 1925 the silt content of the water entering the reservoir averaged 95 of one per cent, this increased to an average rate of 1 8 per cent for the period 1925–1931, and to an average of 2 9 per cent between 1931 and 1934 The rate of silting for this 14 year period increased from 160 acre-feet per annum to 600 acre feet per annum

PRACTICAL SOIL EROSION PREVENTION

Effective control of erosion primarily involves reduction of the soil transporting effect of meteoric waters by those practical methods of land treatment which minimize the rate of off flowage, thereby causing a larger proportion of the rains to sink into the ground at or near where they fall These measures will be, principally (1) Various adaptations of thick growing vegetation to practical farm operations, (2) use of engineering structures and mechanical procedures where applicable, and (3) retirement of steep, excessively erosive land from cultivation Our knowledge of the soils of the country, the topography, the rainfall, the types of agriculture and the rates of erosion and runoff from different kinds of land subjected to various cropping treatments and other uses is now sufficient to reveal finally and conclusively the physical certainty that until the distinctly different kinds of land are treated in accordance with their particular needs, as determined by the physical factors involved, it will be impossible to make any effective headway of a permanent nature against accelerated soil erosion, against the hazards of silting of stream channels and reservoirs, or against destructive floods within numerous drainage basins These physically determined facts take the question outside the domain of opinion, and on the basis of this accumulated knowledge the Soil Erosion Service is proceeding as rapidly as possible, and for the first time in the history of the country, to put through large-scale, impressive demonstrations of erosion prevention and control, such as will show, and to a considerable extent already have shown that it is practicable to control accelerated erosion by an integrated method of land treatment—that is to say, by using all known practical measures for minimizing the runoff from all the erosive land within a given watershed

The Soil Erosion Service now has thirty two erosion projects in thirty one states, comprising an area of approximately twenty eight million acres There is immediate need for increasing these demonstrational projects to some fifty or sixty major areas, along with a considerable number of smaller outlying areas By this it is meant that there should be complete demonstrations in those more important distinctive geographic regions of the country where erosion is known to be a serious problem and where the method of attack must be shaped to accord with differences in soil, topography, rainfall and agricultural practices

THE UNITED STATES DEBATES AND DELAYS

When we consider the fact that in some other parts of the world erosion is being effectively controlled by wise use of vegetation, cropping methods and engineering measures fitted, through integrated land treatment programs, to the different kinds of land in accordance with their individual needs, it seems a pitiful situation that this great nation should stupidly pin the security of its agricultural domain upon a single method of erosion combat, namely, the use of engineering structures alone When we see the descendants of the Incas giving almost complete protection to steep Andean slopes with rather simple methods of vegetative control and field arrangement, on land that was in cultivation at the time of the Spanish conquest about 400 years ago, it would seem that we actually

have much to be ashamed of in our record of disastrous land misuse When we are told that Italy is spending $500,000,000 on her Boniface Integrale" program of land conservation and reclamation, it would seem that those of us who have a real interest in the continuing welfare of the United States should be moved to action whenever those who know something of the subject assert that the nation can not afford not to spend now and in the near future whatever is necessary to conserve our remaining areas of good agricultural land When we find that in parts of Germany much the same method of correct land use as that employed in the program of the Soil Erosion Service has been used for many years, and with a high degree of effectiveness and local satisfaction, in connection with their land programs, it would appear that there should be no undue concern on the part of any patriotic citizen if this program is markedly different from anything which has ever been tried in any important way in the United States When we find Japan, in her program of protecting valuable agricultural lands spending many times the value of those areas occupying erosive slopes for the purpose of protecting valuable tracts of lower land from the ravages of erosion and runoff descending from above, why should we be unduly concerned if in some localities it may be found necessary to spend in some instances as much as the land is worth in order to protect it and thereby lower lying areas affected by it—and at the same time give protection to stream channels and reservoirs from the erosional products discharged from such critical areas?

Flood Control and Silt Prevention

When it is considered that quantitative measurements of erosion and runoff from 12 extensive and highly important types of agricultural soil scattered throughout the country show that grass and similar thick growing crops average 65 times more effective with respect to soil conservation and cause five times as much of the rainfall to sink in the ground at or near where it falls than on the same types of soil occupying the same degree of slope and receiving the same amount of rainfall, but devoted to clean tilled crops, no further argument should be necessary to convince any thinking person that by bringing these densely planted crops more generally into use on the more erosive areas it will be possible to bring about some close approximation of permanent flood control and a large reduction in the hazard of silting of stream channels and costly reservoirs Conversely, it should be clear enough to any one that until this is done—until we strike at the critical points of accelerated runoff from cultivated and overgrazed slopes, from the very crests of ridges down across watersheds where floods really originate and silt loads are picked up—we shall never have any very close approximation of permanent flood control or any important reduction of the hazard of silting, within many drainage basins, at any rate On the basis of accumulated information, it appears entirely practicable to bring about that degree of erosion control and prevention—which really means control of the runoff—over most of the crop lands of the nation and over much of the grazing lands It appears quite possible that this work, which must be done some time regardless of the inclination of any one, would result generally in something like a 25 per cent reduction in the volume of floods, with perhaps greater reduction in some drainage basins If this appraisal of the possibilities of erosion control is correct, then we can in a practical way bring about adequate flood control and a tremendous reduction in the costly filling of stream channels and reservoirs

The Path Ahead

The course that the nation must pursue if this is to be a permanently productive agricultural country seems clearly marked out If we refuse to conserve our agricultural lands, obstinately continuing with old methods that have failed, then we may as well confess that we have consciously chosen to head straight in the direction of land disaster Since posterity can not meet the task and since many farmers are unable to handle all phases of the work that must be done, the responsibility of the government is obvious Aside from this responsibility, the government has a very definite and inseparable interest in the continuing welfare of its remaining areas of good agricultural land

PRESENTATION OF PROFESSOR JULIUS ARTHUR NIEUWLAND, C.S.C., FOR THE AWARD OF THE AMERICAN INSTITUTE MEDAL[1]

By Professor MARSTON TAYLOR BOGERT
COLUMBIA UNIVERSITY

'WELL Father, now that you have taken so much trouble to show me all through your laboratories and explain so fully the conditions under which your research work is carried on, I am more than ever impressed by your splendid record of achievement!"

"Oh!" he said, in his characteristically modest way, "you overestimate what little I have been able to

[1] Hotel Astor, New York, February 7, 1935

accomplish It is true that we have been handicapped somewhat in our investigations by lack of needed equipment, and particularly of an adequate chemical library, but the university has done everything in its power to help me and I have been very happy in my work"

We had spent most of the day together in visiting various departments of the University of Notre Dame, giving me an opportunity of renewing old friendships, and were seated in his little private office which, like its presiding genius, was simple and unpretentious

Born of Flemish parents in Hansbeke, Belgium, on February 14, 1878, only about nine miles along the Bruges road from Ghent, in which latter city 15 years earlier another famous Belgian chemist, Leo Hendrik Baekeland, first saw the light of day, his family emigrated to this country when he was but two years old and settled in Mishawaka, near South Bend, Indiana, where a number of his fellow Belgians were already in residence It was natural, therefore, that in selecting his college he should have chosen the adjoining University of Notre Dame, where he received the A B degree in 1899 and the honorary degree of Sc D in 1911 In 1904, the Catholic University of America conferred a Ph D degree upon him

Ordained a priest of the Roman Catholic Church in 1903, he joined the Congregation of the Holy Cross (C S C), and in 1904 was appointed professor of botany at his alma mater

This chair he filled with distinction for 14 years, acting also as curator of the botanical herbarium and of the E L Greene Herbarium as well as botanical librarian During this period, he founded *The Midland Naturalist,* the first number of which appeared in April, 1909, and which later changed its name to *The American Midland Naturalist* For 25 years he served as its editor, and contributed numerous articles to its pages, as well as to other journals In fact, he tells me that he has already published more articles of research in botany than he will have done in chemistry if he lives a dozen years more, for he is still contributing papers in the botanical field

One reason why his professional career began with botany, rather than with chemistry, was that when he entered the University of Notre Dame they had practically no chemical library and no funds available for the purchase of chemical journals or reference works Books on systematic botany, however, were much less expensive and journal files not so essential By supplying various educational institutions with microscope slides, and in other ways, he earned a little extra money which was promptly invested in botanical books, and in this way he gradually accumulated some 2,500 volumes, as well as over 20,000 plant specimens Upon the death of his former professor of botany, the library and herbarium of the latter became the property of the university, and this added some 4,000 books and over 100,000 plant specimens to what he had already gathered, so that to day Notre Dame still has a better botanical library than a chemical one, and botany still remains his hobby and his relaxation, for he has collected plants in nearly every state in the union As he said to me only a short time ago When out in the wilds, my mind is distracted and becomes acquainted again with old plant friends Seldom do I go into the field without finding something not only new to me but new to botanical science

In 1918, his title was changed to professor of organic chemistry, and he has occupied that chair at Notre Dame ever since For three years (1920–3) he was also dean of the College of Science His chief contributions to the progress of organic chemistry have been in the field of acetylene and its derivatives, although he has published important articles in other fields as well (organic reactions with boron fluoride, lewisite, dyestuffs, hexamethylene tetramine acetals, vulcanization accelerators, alcohols ethers etc)

His first paper on acetylene appeared in 1904, in the *Journal f Gasbeleuchtung* (Vol 48 pp 387–8), and was entitled Some Reactions of Acetylene" It dealt with the electrolytic reduction of acetylene and with its chlorination It was followed two years later by 'Reactions of Acetylene with Acidified Solutions of Mercury and Silver Salts' (with J A Maguire) which, like practically all his subsequent chemical papers, was published in the *Journal of the American Chemical Society* (Vol 28, pp 1025–31, 1906)

Further studies in the chemical field were then interrupted for more than a decade by his duties and activities as professor of botany and, although he was granted a U S Patent (No 1, 326, 367), under date of December 30, 1919, for a Dye bath formed with *p* phenylened amine and mercury compounds," it was not until 1921 that publication in the acetylene group was resumed with his report (with R R Vogt) on the 'Rôle of Mercury Salts in the Catalytic Transformation of Acetylene into Acetaldehyde, and a New Commercial Process for the Manufacture of Paraldehyde,"[2] followed by papers on "Acetylene Compounds with Silver Phosphate and Silver Arsenate" (with P B Oberdoerfer),[3] 'The Preparation of Oxalic Acid from Acetylene" (with Miss Kearns and L Heiser),[4] 'The Catalytic Condensation of

[2] *Jour Am Chem Soc* 43 2071–81, 1921
[3] *Jour Am Chem Soc*, 44 837–40, 1922
[4] *Jour Am. Chem Soc*, 45 795–9, 1923

Acetylene with Benzene and Its Homologs" (with J S Reichert),[5] 'The Catalytic Condensation of Acetylene with Phenols" (with H H Wenzke)[6] and the taking out of a Canadian patent (No 250 295), June 2, 1925, with H W Matheson, for a 'Synthetic resin" manufactured by passing acetylene into a phenolic substance containing sulfuric acid and a mercury salt, at a temperature of 50–150°

In December, 1925, the American Chemical Society held, at Rochester, N Y, its first organic chemistry symposium One of the addresses presented on that occasion was a review by Dr Nieuwland of his researches on acetylene and its derivatives, in the course of which he discussed, among other reactions, the formation of divinylacetylene by passing acetylene over cuprous ammonium chloride I well recall the address and the favorable impression it made

It happened that there was also present at the time Dr Elmer K Bolton, then in charge of the chemical research work of the Dyestuffs Section of E I du Pont de Nemours and Company, Inc, of Wilmington, Del, and now chemical director of that corporation One of the principal initial materials for the manufacture of synthetic rubber then was a hydrocarbon known as butadiene, which was not a natural product but had to be obtained by various synthetic methods, and the corporations interested, abroad as well as here, were eagerly seeking new methods of manufacturing this raw material more cheaply Shortly before (in 1925) this Rochester meeting, Dr Bolton had suggested to his superiors the possibility of obtaining this butadiene from acetylene, by oxidizing the latter to diacetylene and then reducing the diacetylene, but after listening to Father Nieuwland's paper, it occurred to him that if it were practicable to make monovinylacetylene commercially from acetylene, it might offer a still more satisfactory route to butadiene and synthetic rubber Upon discussing the problem with Dr Nieuwland, the latter was of the opinion that it might be feasible, for he had already some evidence that the monovinyl was formed along with the divinyl derivative in the reactions he had described

Accordingly, a group of du Pont chemists, under the able leadership of Dr Wallace H Carothers began that active cooperative investigation with Dr Nieuwland which has achieved such a brilliant success in the discovery of the new synthetic rubber substitute now marketed under the name of "Duprene"

In the course of this research, it was found that, in the presence of a suitable catalyst, hydrogen chloride could be added easily to the monovinylacetylene, with the production of a chlorobutadiene which, on standing, changed (polymerized) to an elastic mass closely resembling natural rubber, and in this way Duprene was born Father Nieuwland's major contributions to this birth of a new industry have been the methods for the preparation of the mono and di vinylacetylenes, and assistance in the determination of the proper catalyst for the addition of the hydrogen chloride Considerable embarrassment has been occasioned him by well meaning but misinformed writers who have constantly referred to him as the inventor of Duprene These misstatements he has done his best to correct, but they still persist and crop up every now and again in the press It is no minifying of Father Nieuwland's work to point out that the discovery of Duprene was not made by him, but by the du Pont Company Without his brilliant contributions to the chemistry of acetylene, however, this splendid accomplishment of the great du Pont organization could not have been realized It was Nieuwland's pioneer work which opened the road to Duprene

[5] *Jour Am Chem Soc*, 45 3090–1, 1923
[6] *Jour Am. Chem. Soc*, 46 177–81, 1924

Although chemically not at all identical with natural rubber (for Duprene contains some 40 per cent of chlorine), it bears a closer physical resemblance to it than any of the synthetic rubbers previously known Those respects in which it differs from the natural product make it superior for some purposes and inferior for others Its physical properties are susceptible of wide variation, depending on the character and amount of vulcanizing agent, reenforcing pigment, etc, compounded with it It is particularly valuable in filling the need for a rubber like material with greater resistance than natural rubber to the solvent action of gasolene, oils and other liquids, as well as to the deteriorating and disintegrating effects of heat and oxidation

Although Duprene can not yet be manufactured at the current price of natural rubber, its selling price nevertheless imposes a limit upon that of the latter

A little over a month ago (December 17, 1934), in the hearings at Washington before the Reciprocal Trade Agreement Committee, the Hon Francis P Garvan, former Alien Property Custodian and now president of the Chemical Foundation Inc, presented a notable address, in the course of which this great benefactor of American chemistry and eloquent champion of our chemical industries had the following to say on the subject of rubber

We consume 65 per cent of the world's production of rubber In 1926, we imported 925,878,000 lbs at an average price of 54 6¢, for which we paid $505,818,000 This year, we are roughly importing the same amount for which we will probably pay an average of 14¢ at a cost to us therefor of $130 000,000

In 1926, under the Stevenson plan (in reality an English Dutch cartel) the price was driven as high as $1 25 a pound. In 1934 the Stevenson plan has been

revived, but under a tighter cartel, and the only reason, as announced in the English press, that the price is not driven up to our people, as it was in 1926, is the fear of encouraging the development of Duprene In other words, this discovery even now is possibly saving us at the rate of $375,000,000 a year

Father Nieuwland's researches and their bearing upon the discovery of Duprene have had a peculiar fascination for me For over 40 years, as a student of organic chemistry, I have followed the numerous attempts made in various countries to synthesize rubber on a commercial scale

It was my good fortune to preside over the meetings of the Organic Section of the Eighth International Congress of Applied Chemistry, held in 1912 in New York and Washington, and at those meetings the rival claims of Great Britain and Germany, in the synthetic rubber field, were vigorously presented by Dr Duisberg of Germany and the late Professor William H Perkin of England

Not long after these meetings, an elderly German chemist, Dr Louis Gottschalk, applied to me for the use of space in our organic laboratories at Columbia University, to carry out experiments in this same field He explained that he had discovered a wonderful new process and all that he needed to perfect it was laboratory space and equipment His process, however, involved the use of steel bombs, the contents of which were heated to enormous pressures It was explained to him that we could not undertake anything so hazardous, for if one of those bombs exploded the effect would be as devastating as the explosion of a 12 inch shell So he organized the Alembic Process Company, with his wife, his son in law (George Titus) and a chemical engineer (Clifford D Meeker) as his associates, and established a laboratory at Sewaren, N J On September 14th, 1913, one of these bombs let go and killed his wife instantly Six months later, a second bomb exploded, blew Mr Meeker and the laboratory to bits and seriously injured Mr Titus That was the last I ever heard of Dr Gottschalk or his 'alembic process"

The layman is familiar with the facts that acetylene is the gas commonly used for household lighting in those isolated or back country districts where neither electricity nor the ordinary illuminating gas are available, that it was employed also in the old fashioned automobile headlights, and that its chief service to day is in oxy acetylene torches for cutting and welding He may know also that this gas is generated by the action of water upon calcium carbide and that the carbide is manufactured by heating in an electric furnace a mixture of lime and carbon, but that is usually as far as his information extends

To the chemist, however, acetylene is of transcendent interest, because it is in many respects the most fundamental and most valuable building unit for the whole vast structure of synthetic organic chemistry, for Berthelot showed more than 70 years ago (January, 1863), that acetylene could be prepared by passing an electric arc between carbon poles in an atmosphere of hydrogen, in other words, that acetylene could be produced from the elements carbon and hydrogen themselves, and this gas is a highly unsaturated compound, which unites so avidly with certain elements that violent explosions ensue In the presence of suitable catalysts, and when no other substance is at hand, it will unite with itself, that is to say its constituent molecules combine to larger aggregates, polymerize,' as the chemist calls it, and in this way mono and divinyl acetylenes are formed

It is no exaggeration to say that hundreds of thousands of carbon compounds can be built up step by step from acetylene, for it is not only the foundation of what is known as aliphatic chemistry but of aromatic chemistry as well, both isocyclic and heterocyclic Products of vital functions, indispensable drugs, dyestuffs, perfumes, plastics and an innumerable host of other useful compounds can be obtained from this remarkable hydrocarbon

Is it any wonder, then, that Father Nieuwland should have elected to study more closely its chemistry, even though he realized that such experiments were fraught with some peril to the experimenter? In the course of his work he has of course, had some explosions, but fortunately without any tragic results, and he has finally tamed these dangerous forces so that now, when he addresses them sternly, they reply obediently, 'Yes, Father!'

Unlike certain governmental officials who are so successful in making two lemons grow where only one grew before and then handing them both to you when you are not looking, Father Nieuwland has really made new compounds grow and blossom where none were known before and by his discoveries has contributed to the founding of a new and most promising industry

Many of the facts he utilized in this achievement had lain buried in the literature for decades, waiting patiently for the arrival of that master who should fit them into their proper places in some worthwhile plan for the progress of science and industry

Professor Nieuwland is a member of many scientific societies both here and abroad, and has been the recipient of numerous honors

He was president of the Indiana Academy of Science during its Jubilee year (1934) In 1933, he received the John Motley Morehead Medal of the

National Acetylene Association and has just recently been awarded the William H Nichols Medal of the American Chemical Society, "for basic work on syntheses from unsaturated hydrocarbons" The ceremony at which this latter medal will be presented to Father Nieuwland is planned to be one of the outstanding features of the celebration of the tercentenary of the founding of the American chemical industries, to be held in this city during the week of April 22, in connection with the eighty ninth meeting of the American Chemical Society

Modest, unassuming, a most delightful companion and lovable personality, to know him is to become immediately his warm friend and admirer

Mr President, I now have the honor to present Julius Arthur Nieuwland, eminent chemist and botanist, for the award of the Gold Medal of the American Institute In the citation of our Council on Awards, this distinction is recommended "for a life-time of patient research devoted to new fields of organic synthesis based on acetylene, to which he has made notable contributions"

OBITUARY

HERDMAN FITZGERALD CLELAND

HERDMAN FITZGERALD CLELAND, Edward Brust professor of geology and mineralogy at Williams College, was born at Milan, Illinois, July 13, 1869, the son of David J and Margaret (Betty) Cleland He met a tragic death in the *Mohawk* disaster on January 24, 1935, while en route to Yucatan with a party of young men whom he was to guide in the study of the Mayan remains Three of the students, all seniors at Williams, shared his fate

Cleland was of Scotch and Irish ancestry His grandfather, Samuel Cleland, was a graduate of the University of Glasgow and of the Theological School at Belfast College He came to the United States in 1826, and was pastor of various Presbyterian churches in Ohio, Iowa and Illinois till his death in 1865 Cleland's maternal grandfather, John Betty, came to this country from Ireland in 1842 and was engaged in various commercial enterprises Herdman inherited a tradition of culture, refinement and scholarship His thrifty Scotch training was a lifelong advantage He lived simply but well, always managing to set aside something to be used in helping others President Tyler Dennett has said of him "He was also generous, one of the most generous citizens of Williamstown, not in ostentatious ways, but quietly and simply as he lived I am told that there is more than one family in our village which, due to his help, now owns the roof over their heads There are others, many of them, who learned that when in sore need they could find both sympathy and substantial help A model teacher, he was in equal degree a model citizen"

His last reported words, "I'm sorry the trip is off, boys, but I wish they had waited till the water was warm before they threw us in," show that he faced the end with the same calm courage and dry humor that had carried him through other crises in his life Although quiet and reserved, he had an infinite capacity for making friends, to whom his conversation was a delight He was fastidious, physically and mentally, and was annoyed by much which he saw and read, but his criticisms generally emerged as witty remarks which did not sting, yet were so pointed that they often produced good results He was forthright and frank, yet withal so just that he aroused no personal antagonism The mass production of the lecture system did not appeal to him He was profoundly interested in each of his students, ever ready with counsel, advice and stimulation That his students were well trained is attested by the records of the geologists who have graduated from Williams during the last thirty three years His instruction and his personality equally influenced a majority of his students who did not become professional geologists

Cleland's early education was greatly delayed by the inadequacy of the schools in the small frontier town in which he passed his earlier years He received a part of his preparatory training, and took two years of undergraduate work, at Gates College in Nebraska, but received his A B at Oberlin in 1894, where his interest in geology was fostered by the late Professor Alfred A Wright After graduation, ill health forced him to return for a year to the home of his father at Pierce, Nebraska He attended the summer session of the University of Nebraska in 1895, and that fall entered upon the duties of professor of natural sciences at Gates College, where he remained three years A summer at the University of Chicago in 1896 crystallized his leanings toward geology, and, realizing the difficulty of teaching all the natural sciences, he gave up his position at Gates College in 1898 That autumn he entered the graduate school at Yale, studying chiefly under Henry Shaler Williams, then the outstanding exponent of stratigraphic paleontology He received his degree of doctor of philosophy there in June, 1900

Being at a loose end, he that summer joined the first of the notable peripatetic summer schools con-

ducted by Professor Harris of Cornell This company, which included professors, doctors of philosophy, graduate students, school teachers and a few advanced undergraduates concentrating in geology, was admirably adapted for mutual instruction It was particularly inspiring to the present writer, whose previous contact with geology had been confined to the reading of such out of-date text books as were to be found in a small town library That ten weeks was the equivalent of the ordinary undergraduate training in the subject, for there were no soon forgotten lectures Everything which was said applied to objects before the eyes of the party at the moment Thus we were taught not only to reason backward from result to cause, but, through the multiplicity of teachers, were made to realize that most phenomena have more than one plausible explanation

The writer owes much to all members of that party, but most to Cleland, for despite the fact that he was denominated Doctor, and that I was a prospective junior turning to geology after two years in the College of Engineering, he undertook the task of seeing that I understood the results of every discussion He was always ready to answer questions, and, best of all, he was equally ready to admit that certain questions could not be answered by him or had as yet no answers No greater stimulus for further study or original research is possible

Cleland spent the ensuing year at Cornell, engaged in research and teaching During Professor Harris's absence in the winter term, which he then devoted to his duties as state geologist of Louisiana, Cleland gave the courses, one of which was devoted to a detailed discussion of the fossil Brachiopoda

In the autumn of 1901, he was called to Williams College, where he was instructor in geology and botany till 1904, assistant professor till 1907, when he became professor of geology and mineralogy After teaching all the sciences, he was at last in a position to teach one Even so his task was not simple He had to build up a department and a museum He succeeded in doing both

Cleland's early researches were in the realms of paleontology and stratigraphy His doctoral dissertation, published as a Bulletin of the U S Geological Survey, was a very detailed study of the distribution of the fossils in the Hamilton formations exposed along Cayuga Lake He later described the fauna of the Mid-Devonian strata at Milwaukee, Wisconsin, and also published two important papers descriptive of the Beekmantown fossils of the Mohawk Valley He subsequently withdrew almost entirely from this field, devoting himself to his first text-book, "Physical and Historical Geology" (American Book Company, New York, 1916), and to other geological subjects, particularly the origin of natural bridges His 'Practical Applications of Geology and Physiography" (Excelsior Press North Adams) appeared in 1920

Later in his life his interests changed again Numerous trips to Europe, some of them prolonged, brought him in contact with the vestiges of prehistoric civilizations He took up particularly the study of the Neolithic and later ages, a part of the story of ancient man commonly considered to be outside the province of the geologist This led to his interesting book, 'Our Prehistoric Ancestors (Coward McCann Inc, New York, 1928) His last work was a little volume entitled, 'Why be an Evolutionist?', 1930

Cleland was a fellow of the American Association for the Advancement of Science, American Academy of Arts and Sciences Geological Society of America (councilor, 1928–31), Paleontological Society (secretary, 1909), American Geographical Society member Seismological Society, American Institute of Mining and Metallurgical Engineers, American Archeological Society, New York Academy of Science Phi Gamma Delta, Sigma Xi and Phi Beta Kappa (honorary member)

He was married twice, first to Helen Williams Davison, and, after her death, to Emily Leonard Wadsworth His widow, four daughters, a brother and a twin sister, Elizabeth, who has ever been his help in time of trouble, survive him

A man of high ideals broad culture, wide interests and an unusual personality has suddenly been taken from us A host of former students and colleagues mourn him

PERCY E RAYMOND

RECENT DEATHS

PROFESSOR WILLIAM JOHN SINCLAIR for thirty years a member of the department of geology of Princeton University, died on March 25 He was fifty seven years old

SIR EDWARD SHARPEY SCHAFER, professor emeritus of physiology at the University of Edinburgh, died on March 29 at the age of eighty four years The council of the University of Edinburgh had approved on March 19 the establishment of a Sharpey Schafer Lectureship in physiology, a fund for its endowment having been contributed by his pupils and friends

AKIRA FUJINAMI, professor emeritus of the Kyoto Imperial University, died on November 18, 1934 To workers in cancer research the late Professor Fujinami is known for his first discovery of a transplantable chicken sarcoma and for his work on a neoplasm of this type

SCIENTIFIC EVENTS

THE ANNUAL REPORT OF THE DIRECTOR OF THE FIELD MUSEUM OF NATURAL HISTORY

THE annual report of Stephen C Simms, director of the Field Museum of Natural History, has been issued The continued financial difficulties which confront the museum as a result of depression are emphasized in Mr Simms's introductory remarks to a description of the work carried out in 1934 He writes

The budget adopted was again substantially reduced, and no expeditions or purchases of collections were provided for except where made possible by contributions for specific new research during the year As anticipated, income from endowments and tax collections was less than in 1933, income from contributions was very much smaller, and, while the downward trend in income from memberships was greatly retarded, there was nevertheless a reduction of receipts from that source Revenues from admissions and sundry receipts, which in 1933 were far above average, decreased in 1934 as a natural result of the smaller number of visitors, especially those from out of town, to the Century of Progress exposition in its second year By rigid economies the museum succeeded in keeping actual expenditures well within budget appropriations and was enabled without reduction in salaries or personnel to cover its essential operating expenses, and to reduce notes payable caused by previous years deficits from $105,000 to $95,000

Donations of funds received by the museum in 1934 include gifts from Marshall Field, of New York and Chicago, of $26,140, from Mrs Oscar Straus, of New York, of $11,105, and from Mrs James Nelson Raymond, Chicago, of $4,000 A bequest of $100,000, subject to the life interest of Frederick R Babcock, is provided in the will of the late Mrs Abby K Babcock Income of $2,500 was received from a bequest of the late Mrs Augusta N Rosenwald Large amounts of material for addition to the exhibition and reference collections, and for the library, were received from friends of the museum.

On the museum's attendance in 1934, Mr Simms reports in part as follows

Insofar as those activities directly connected with serving the public are concerned, the museum, despite the severe economies which had to be instituted, managed to maintain its customary standards The number of visitors at the museum was 1,991,469, which, while it represents a large decline from the attendance of 3,269,390 recorded in 1933, was nevertheless the second highest year's attendance in the history of the institution. The decline from the 1933 peak was a natural and expected consequence of the smaller attendance experienced by A Century of Progress.

Taking into consideration extra mural activities, the museum's educational influence was carried directly to a total of more than 2,650,000 persons during 1934 This figure includes the visitors received in the building itself, together with approximately 662,000 persons (chiefly children) reached by the outside work conducted by the institution through the James Nelson and Anna Louise Raymond Foundation for Public School and Children's Lectures, and the Department of the N W Harris Public School Extension Only 99,553 persons, or approximately 5 per cent of the total attendance, paid the 25 cent admission fee

Lectures in the schools and motion picture programs at the museum, provided by the Raymond Foundation, reached 213,579 children The traveling natural history exhibits of the Harris Extension were circulated to more than 400 schools where approximately 500,000 children saw them daily

The report contains detailed accounts of the many new exhibits added during the year, of research conducted by the departments of anthropology, botany, geology and zoology, of the several expeditions which were made possible by special contributions and of all other activities of the museum.

SOIL EROSION CONTROL

To unify all soil erosion control activities of the federal government, Secretary of Agriculture Henry A Wallace has issued an order establishing a separate soil erosion unit in the Department of Agriculture Under Secretary R G Tugwell has undertaken the task of consolidating the various departmental units working in this field The base of the new organization will be the Soil Erosion Service, which has just been transferred to the Department of Agriculture from the Department of the Interior, this transfer was authorized by the Public Works Board at the request of the President

All investigational, service and control projects on erosion, heretofore under the supervision of the Bureaus of Chemistry and Soils, Agricultural Engineering and Plant Industry and the supervision of CCC erosion control work now under direction of the Forest Service, were transferred on April 1 to the new unit

H H Bennett will head the consolidated activities. Mr Bennett has been in charge of the Soil Erosion Service since it was organized, and previously was in charge of soil erosion investigations of the Bureau of Chemistry and Soils

Research into the soil, plant and engineering aspects of the cause and methods of controlling erosion will continue to be conducted at ten field stations Using the facts developed by this research, large-scale demonstrations will be continued in various parts of the country

The recent dust storms, as well as the severe dust storm of May, 1934, forcibly called the attention of city and country people to the seriousness of wind

erosion. Water erosion, of course, is much more wide spread and destructive because it is a continuous process in many parts of the country. More than 50 million acres of land in the United States has been destroyed for crop production by erosion. Another 125,000,000 acres of land new in crops has lost all or most of its topsoil. About 100,000,000 acres is rapidly approaching that condition. At least three fourths of the farm land of the United States used for clean tilled crops is subject in varying degrees to erosion, the damage from which to farm lands, roads, reservoirs, irrigation ditches and valley lands is estimated at more than $400,000,000 a year. Studies in Oklahoma show that cultivated fields lost 84 per cent more rainfall and 667 times more soil than similar fields that were under a grass sod.

The Bureau of Agricultural Engineering has studied control of erosion by artificial structures such as terraces, tile drains, check dams and soil saving dams. The field research of the Bureau of Chemistry and Soils and Agricultural Engineering has been conducted at field stations at Bethany, Mo., Guthrie, Okla., Hays, Kans., LaCrosse, Wis., Clarinda, Iowa, Pullman, Wash., Statesville, N. C., Temple, Tex., Tyler, Tex., and Zanesville, Ohio. The Bureau of Plant Industry, in addition to introducing and selecting plants best suited for use in soil erosion control work, recently established large scale soil erosion nurseries on which will be grown various plants for use in control projects. These nurseries have been financed with emergency funds.

Research primarily discovers how erosion may be controlled most effectively and economically. These results are translated into action by farmers themselves and by the Soil Erosion Service which is demonstrating effective methods of land conservation in forty erosion control projects in 32 states. Ranging in size from 50,000 to 16,000,000 acres each, these projects cover representative watersheds in the major agricultural sections where erosion has become a critical problem.

THE ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

THE sixty fourth annual meeting of the American Public Health Association will be held in Milwaukee, from October 7 to 10. The society has a membership of 4,500 professional public health workers whose annual sessions review developments in health protection and promotion and outline plans and policies for future advances.

Several related organizations have announced that they will meet simultaneously with the association at Milwaukee. They are: American Association of School Physicians, International Association of Dairy and Milk Inspectors, Conference of State Sanitary Engineers, International Society of Medical Officers of Health, Association of Dairy, Food and Drug Officials, Conference of Wisconsin Health Officers, Conference of State Laboratory Directors and Association of Women in Public Health.

The fourth Health Education Institute sponsored and conducted by the association will be held on October 4, 5 and 6, prior to the opening of the several conventions. The subject will be "Health Education in Small Cities and Rural Communities."

A Health Exhibit including in its scope commercial, scientific and educational displays will be conducted as usual at Milwaukee.

Plans for the preliminary program include special sessions on The Rôle of a Health Department in a Program of Social Security, Mental Hygiene, Professional Education, Veterinary Public Health, Diphtheria Immunization, and a session on the history and achievements of the Committee on Administrative Practise, celebrating its fifteenth anniversary.

The association is divided into ten sections—Health Officers, Laboratory, Vital Statistics, Public Health Engineering, Industrial Hygiene, Food and Nutrition, Child Hygiene, Public Health Education, Public Health Nursing, Epidemiology. Subjects to be discussed include pneumonia, trench mouth, syphilis, measles, outdoor bathing places, scarlet fever, milk sanitation, water sanitation, foods, health education, and many other topics representing the responsibilities of health authorities.

The chairman of the Local Committee on Arrangements is Dr. John P. Koehler, Health Officer of Milwaukee. Information in regard to the congress can be obtained from the American Public Health Association at 50 West 50th Street, New York City.

THE LOS ANGELES MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A PRELIMINARY announcement of the forthcoming meeting of the Pacific Division to be held at the University of California at Los Angeles during the week of June 24, 1935, will be distributed to members early in April.

Two of the principal addresses to be presented during the meeting will be given by Professor Bailey Willis, president of the Pacific Division, and Fred E. Wright, of the Geophysical Laboratory, Washington, D. C. The subject of Professor Willis's address will be "The Living Globe," while that by Mr. Wright will be on "The Surface of the Moon."

The meetings will open formally on the morning of Tuesday, June 25, with a general symposium on "The

Earthquake Situation" The following topics will be discussed

"Historically Recorded Earthquakes in California" Owen C Coy, University of Southern California, Los Angeles

"Seismologic Research"

(a) Earthquakes of Northern California, Perry Byerly, University of California, Berkeley

(b) Research on Near and Far Earthquakes, B Gutenberg, California Institute of Technology, Pasadena

(c) Vibration Research for Earthquake resistant Buildings, L Jacobsen, Stanford University

(d) Development of the U S Coast and Geodetic Survey Seismological Program in California, T J Maher, U S Coast and Geodetic Survey, San Francisco

Mechanics of Earthquake Activity' Bailey Willis, Stanford University

The Construction of Earthquake resistant Buildings' Geo B McDougall, state architect, Sacramento

The afternoon of Tuesday, June 25, will be devoted to a series of reviews on the progress of research in selected fields of general interest Attention will be centered upon a few of the most noteworthy achievements described in relation to outstanding developments and problems of commanding interest in the fields at large The reviews will be presented as follows

"Recent Developments in Acoustics" V O Knudsen, University of California at Los Angeles.

"The Mechanism of Heredity" Th Dobzhansky, California Institute of Technology

"Recent Developments in the Field of Hormones" B M Allen, University of California at Los Angeles

On the morning of Wednesday, June 26, a symposium on "The Virus Diseases of Plants and Animals" will be held under the auspices of the American Phytopathological Society, Pacific Division, Botanical Society of America, Pacific Section, Society for Experimental Biology and Medicine, and the Western Society of Naturalists

The remainder of the week will be given over to the programs of participating societies of which seventeen or eighteen will be joining in the meeting

Members proposing to present papers are reminded that titles received after May 1 will be too late for publication in the program This will be distributed during the last week of May to all members of the association resident in the territory of the Pacific Division

Many excursions of considerable interest are being arranged and will be described in full in the program

J MURRAY LUCK,
Secretary

SCIENTIFIC NOTES AND NEWS

ON the occasion of his eighty second birthday on March 29 Professor Elihu Thomson was presented with the medal of honor of the German Society of Engineers The presentation was made at a luncheon of the board of directors of the General Electric Company Among those present were Owen D Young, Gerard Swope, Philip Stockton, Charles F Adams and Francis Lee Higginson Because of Professor Thomson's ill health Edwin W Rice, Jr, accepted the medal, which was presented by Kurt von Tippleskirch, German consul in Boston As translated the inscription on the medal reads "On Elihu Thomson, the great pioneer in the realm of engineering, the inventor and scientist, the promoter of cooperation among engineers, there is conferred on his eighty second birthday the V D I medal of honor"

THE Kelvin Gold Medal for 1935, awarded triennially as a mark of distinction in engineering work or investigation of the kinds with which Lord Kelvin was especially identified, has been conferred on Sir John Ambrose Fleming, in recognition of his services to electrical science and particularly of his invention of the thermionic valve The presentation ceremony is expected to take place at a meeting of the British Institution of Civil Engineers early in May

DR IRVING LANGMUIR, of the General Electric Company, and Professor Harold C Urey, of Columbia University, will be the guests of honor at a dinner on Monday evening, April 22, one of the opening events of the tercentenary celebration by the American Chemical Society of the founding of the nation's chemical industries The dinner will be given by the Division of Physical and Inorganic Chemistry Professor Victor K LaMer, of Columbia University, will preside

A PORTRAIT of Dr Martha Tracy, dean of the Woman's Medical College of Pennsylvania, was presented to the college on its eighty-fifth anniversary on March 9 This is Dr Tracy's twenty-fifth year at the college Dr Ellen C Potter, Trenton, N J, made the presentation Dr Helen Ingleby, professor of pathology, on behalf of trustees, faculty, students and friends, presented an automobile to Dr Tracy.

THE Cross of the Legion of Honor was conferred on March 26 by Consul General Charles de Font-

nouvelle of France upon David Sarnoff, president of the Radio Corporation of America, "in recognition of his pioneering and great accomplishments in the science of radio" The presentation took place in the Consulate General in La Maison Française, of the Rockefeller Center, New York City

M CHARLES POISSON has been elected correspondent of the Paris Academy of Sciences in the place of the late William Morris Davis

DR HAROLD ST JOHN, professor of botany at the University of Hawaii, has been elected a corresponding member of the Czechoslovakian Botanical Society

PROFESSOR W N HAWORTH, director of the department of chemistry of the University of Birmingham, has been elected a corresponding member of the Bavarian Academy of Sciences

THE Bessemer Gold Medal for 1935 of the British Iron and Steel Institute has been awarded to Professor A M Portevin, of Paris

THE Duddell Medal has been awarded by the Physical Society, London, to Dr W Ewart Williams, of King's College, London, for his work in optical design in the field of interferometry

AN award of $10,000 has been made to Miss Lillian Banks, of Norfolk, Va, whose design has been accepted for the "universal memorial light" to Thomas Alva Edison

DR. THOMAS S FISKE, since 1897 professor of mathematics at Columbia University, will retire at the end of the academic year with the title emeritus professor Dr Fiske received the degree of A B from Columbia in 1885 and since then has been continuously connected with the university Since 1901 he has been secretary of the College Entrance Examination Board He was from 1902 to 1904 president of the American Mathematical Society, of which he had been secretary and editor of the *Bulletin* and *Transactions*

PROFESSOR KARL S LASHLEY, now at the University of Chicago, has accepted an appointment as professor of psychology at Harvard University

DR DAVID A TUCKER, JR., associate clinical professor of contagious diseases at the University of Cincinnati College of Medicine, has been appointed professor of the history of medicine

DR. J H SIMONS, secretary of Section C of the American Association for the Advancement of Science, has been appointed associate professor of physical chemistry at Pennsylvania State College

DR. JOSEPH TANNENBERG, professor of pathology at the University of Frankfurt, has arrived in Albany to assume for one year the post of director of Bender Hygienic Laboratory He succeeds Dr Arthur W Wright, now professor of pathology and bacteriology at the Albany Medical College

DR. ETHEL C DUNHAM, associate clinical professor of pediatrics at the Yale University School of Medicine, has been named acting director of the division of maternal and child health, U S Children's Bureau Dr Dunham graduated from the Johns Hopkins University School of Medicine in 1918

DR. JULES BLACHE, professor of geography in the University of Grenoble, is the exchange professor from France at Harvard University during the current half year While here he is offering one regular course on the "Geography of Mountains" and giving a series of eleven public lectures on the general heading of "Geography of French Agriculture"

AN Institute of Experimental Surgery has recently been inaugurated at the Medical Faculty of Buenos Aires, under the direction of Dr Guillermo Bosch Ayana, professor of operative medicine

THE R A F Penrose, Jr, memorial lecture of the American Philosophical Society will be delivered on April 18 by Dr W F G Swann, director of the Bartol Research Foundation of the Franklin Institute, Philadelphia. He will speak on 'The Second Law of Thermodynamics"

THE Edgar Marburg Lecture of the American Society for Testing Materials will be delivered at the annual meeting to be held in Detroit from June 24 to 28 by Dr L B Tuckerman, chief of the Division of Mechanics and Sound of the National Bureau of Standards The lecture will be on the general field of the development and application of materials in the aircraft industry

THE fifth Joseph Henry Lecture of the Philosophical Society of Washington was delivered on March 30 by Dr Paul R Heyl, of the National Bureau of Standards The title of the lecture was "What is Electricity?"

DR GLEB V ANREP, professor of physiology at the Egyptian University at Cairo, delivered the Edward Gamaliel Janeway Lectures at Mount Sinai Hospital, New York City, on March 25 and 26 His subjects were "The Duodenopyloric Mechanism in Relation to the Sympathetic Nervous System" and "The Coronary Blood Flow in Relation to Pulse Pressure" Dr Anrep will give the Lane Medical lectures at Stanford University from April 22 to 26

DR. C C LITTLE gave the annual initiation address to the Brown University Chapter of Sigma Xi on March 21 on "Some Recent Advances in Cancer Research" He also spoke informally at the Faculty Club luncheon on "Birth Control and its Social Implications"

DR. T. WINGATE TODD, professor of anatomy at the School of Medicine of Western Reserve University, Cleveland, spoke on March 18 before the Thomas P. Hinman Mid-Winter Clinic at Atlanta, Ga., on "The Physical Constitution of the Growing Child." He also made an address at the University of Georgia on "Negro Child Development."

DR. WILLIAM W. CORT, professor of helminthology at the Johns Hopkins University School of Hygiene and Public Health, will deliver the Gehrmann lectures of the University of Illinois College of Medicine, from April 8 to 10. The titles of the three lectures are "Studies on Ascariasis in Children in the United States", "Epidemiology and Control of Schistosomiasis (*Bilharziasis*) in Egypt," and "Present Status of the Hookworm Problem in the United States."

PROFESSOR J. B. S. HALDANE delivered at the University College of Swansea on March 13, 14 and 15 a course of three public lectures on "Human Heredity."

THE American Institute of Nutrition will meet at Detroit on April 10.

THE Wisconsin Academy of Sciences, Arts and Letters will hold its sixty-fifth annual meeting on April 12 and 13 in Beloit as guests of Beloit College. The Wisconsin section of the American Chemical Society will meet with the academy on April 13 for the presentation of a program of fourteen papers.

THE Mobile Academy of Science was organized by a group of some twenty-five teachers of science, physicians and others interested in the subject living in and around the city of Mobile, on Wednesday, March 27. The following officers were elected: *President*, the Rev. Dr. P. H. Yancey, S.J., professor of biology at Spring Hill College; *Vice-president*, Dr. Toulmin Gaines, dermatologist of Mobile; *Secretary*, Matt Lawler, physics teacher in Murphy High School, Mobile. The academy will meet once a month to hear scientific papers by the members or invited speakers and will also undertake field trips for the study of geology, archeology, botany and zoology.

THE meetings of the Georgia Academy of Science, the Southeastern Section of the Mathematical Association of America, the Georgia Section of the American Chemical Society, and the initial meeting of the Southern Section of the American Physical Society held at Agnes Scott College, Decatur, Georgia (except the Saturday session of the Physical Society, at Emory University), March 22 and 23, had an attendance of over four hundred. This perhaps represents the largest group ever to convene in Georgia. Sixty-eight papers dealing with research work of the members were read. The following additional papers were given by guest speakers: "Cosmic Rays on Seven Continents," A. H. Compton, University of Chicago (Agnes Scott Lecture Association); "Glass, an Indispensable Factor in Modern Civilization," Alexander Silverman, University of Pittsburgh (Georgia Academy of Science and the Georgia Section of the American Chemical Society), and "Movement of Mercury's Perihelion" and "The Place of Mathematics in Secondary Education," K. P. Williams, Indiana University (Southeastern Section of the Mathematical Association of America).

THE Science Forum of the New York Electrical Society presented on March 27 a symposium entitled "Scientific Education—What is Wrong with It?" The speakers were Dr. Harry Woodburn Chase, chancellor of New York University; Dr. William E. Wickenden, president of the Case School of Applied Science, Cleveland; Dr. Colin G. Fink, head of the division of electrochemistry, Columbia University, and Dr. Alan Gregg, director of the division of the medical sciences at the Rockefeller Foundation.

A DINNER celebrating the hundredth anniversary of the birth of Alfred Nobel will be held in the Grand Ballroom of the Waldorf-Astoria on April 9. It has been decided to make of this an annual event, with Nobel laureates of the current year as the guests of honor. Drs. George R. Minot, William P. Murphy, H. C. Urey and G. H. Whipple have indicated their intention to be present and all others who have in previous years received a Nobel prize have been invited to attend. Dr. Foster Kennedy will act as toastmaster and other guests of honor and speakers will include Dr. Alan M. Chesney, dean of the Medical School of the Johns Hopkins University; Dr. David L. Edsall, dean of Harvard Medical School; Dr. Willard C. Rappleye, dean of the College of Physicians and Surgeons, Columbia University, and Dr. M. Charles Winternitz, retiring dean of the Medical School of Yale University.

A TWO-DAY conference of the advisory council of the Milbank Memorial Fund was held on March 29 and 30 at the New York Academy of Medicine, at which questions of tuberculosis control, population problems, health education and other allied subjects were discussed at round table meetings. Among the speakers at the annual dinner of the Board of Directors were Miss Josephine Roche, assistant secretary of the treasury; Dr. Hugh S. Cumming, surgeon general, the United States Public Health Service; Dr. Livingston Farrand, president of Cornell University; Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, and Albert G. Milbank, president of the fund. Others who took part in the con-

ference were Dr E R Baldwin, director of the Trudeau Foundation, Saranac, Dr Robert L Dickinson, secretary of the National Committee on Maternal Health, Dr Louis I Dublin, third vice president of the Metropolitan Life Insurance Company, Professor Henry Pratt Fairchild, of New York University, Homer Folks, secretary of the State Charities Aid Association, and Dr John A Hartwell, director of the New York Academy of Medicine

SIGMA PI SIGMA, honorary physics society, installed its twenty ninth chapter at the Michigan State College on March 2 when the charter was presented to a group of thirty nine students and faculty members by Dr Marsh W White, executive secretary Dr Robert H Spahr, director of instruction and curricula at the General Motors Institute, Flint, Mich, and Dr R W Smith, research associate at the University of Michigan, assisted the installing officer in inducting the petitioning group as the Alpha Epsilon chapter of the society Dr E F Barker, professor of physics at the University of Michigan, was initiated as an honorary member of the society and, after the installation banquet, gave an address on "The Modern Alchemist" at the first open meeting of the chapter

LECTURES at the New York Botanical Garden, to be held on successive Saturday afternoons at 3 30 o'clock from March 30 to April 23, are as follows 'Molds and Mushrooms that Cause Human Ills," Dr J Gardner Hopkins, College of Physicians and Surgeons, Columbia University, and Dr B O Dodge, plant pathologist, South African Flowers and Scenery," Mrs Jerome W Coombs, Federated Garden Clubs of New York State, "Annuals for the Garden," T H Everett, horticulturist, 'Summer flowering Bulbs," Dr Forman T McLean, supervisor of public education, 'Spring Wild Flowers," Dr John Hendley Barnhart, bibliographer and administrative assistant, 'The New York Botanical Garden Its History and Its Work," Dr Marshall A Howe, assistant director, "Lilies for Gardens," Dr A B Stout, director of the laboratories, "The Flora of the Watchung Mountains," Dr Harold N Moldenke, assistant curator, 'The First Families of Florida and their Crops," Dr H Beaman Douglass, physician

WE are informed through the courtesy of the general secretary of the International Committee of Annual Tables of Constants, M Ch Marie, Paris, that the Academy of Sciences of the U R S S has signed an agreement with the committee, guaranteeing for the coming five years a contribution to the international fund for the publication of Annual Tables of Constants In exchange the academy will receive a certain number of volumes edited by the committee These volumes will be distributed among the universities and scientific institutions of the Soviet Union Similar agreements have been already signed with the French Government, the Helvetic Government and the Polish Academy of Sciences

THE Johns Hopkins University School of Medicine has received an additional gift of $150 000 from the estate of Joseph Raphael DeLamar, who died in 1918 The *Journal* of the American Medical Association reports that a fund of $4,706,450, which has been paid to the medical school over a period of years under Mr DeLamar's will, supports many activities, including the DeLamar Lectures in Hygiene at the Johns Hopkins University School of Hygiene and Public Health The will provided that, after other bequests had been made, the residue was to be divided so that one third went to the medical school and another third to the College of Physicians and Surgeons of Columbia University This is the authorization for the recent gift The DeLamar Lectures were established to give to the people of the United States generally the benefits of increased knowledge concerning the prevention of sickness and disease and also concerning the conservation of health by proper food and diet"

THE estate of Mrs T Coleman du Pont, at Irvington on Hudson, has been given to Columbia University The property consists of sixty eight acres, on which there is a mansion, and probably will be used in studies of landscape architecture conducted by the Columbia School of Architecture The estate extends from the Albany Post Road to the Hudson River and now has four acres in flowers Mrs du Pont made the gift in memory of her husband With the estate will go a fund sufficient for maintenance for three years

THE University of Michigan has been granted a fourth of the estate of the late Bernard C Hesse, the New York chemist, valued at $123,073 Dr Hesse graduated from the university in 1893

ACCORDING to the *Journal* of the American Medical Association, continuance of a dental research project in Yale University School of Medicine has been made possible through a grant of $17,500 by the Carnegie Corporation of New York. This program, instituted in July, 1929 under a grant of the Rockefeller Foundation, is an intensive study of the teeth in relation to the body in general by physicians, radiologists, bacteriologists, pathologists and dentists The original study group included Dr Milton C Winternitz, Dr Samuel C Harvey, the late Dr William A LaField, Dr Félix d'Herelle, Dr George H Smith, Dr Raymond G Hussey and Dr William Downs, Jr

DISCUSSION

THE NEBRASKA EARTHQUAKE OF MARCH 1 1935

RESIDENTS within an area of 50,000 to 75 000 square miles in Nebraska, Iowa, Missouri and Kansas were awakened by mild but distinct earth tremors at 5 00 and 5 03 A M on March 1 No damage of any importance has been reported Two distinct tremors occurred, each lasting about 10 seconds, about 3 minutes apart

In a few cases vases or other small objects were shaken off from small unsteady tables The writer was awakened by the second tremor The vibrations seemed to oscillate in an east west direction The bed vibrated in this direction and the spring was tapping the footboard when the writer awakened The mirrors of a high vanity dresser standing against the east wall of the room were also loudly clattering against the wall

The writer also noted a very distinct rumbling accompanying the tremors It greatly resembled the rumble of a heavy freight train Many other persons also noted the rumble, and some have stated that the rumble preceded the actual tremors by a few seconds The writer at first thought that the rumble might be that of a train but it ceased immediately when the tremors stopped This was noted at the time Subsequently, other persons have reported the rumble from country homes too remote from trains or street traffic to leave any room for doubt of its connection with the earthquake

The rumble was so distinct that the writer feels it should be specially noted Since the mechanical vibrations which constitute the tremors may be and commonly are of audio frequency, sound is a natural accompaniment of an earthquake However, the sound vibrations set up by earth tremors are frequently masked by other noises and the commotion that often accompanies such events The quiet of the morning hour and the mildness of the tremors, unaccompanied by the noise of crumbling masonry, *et cetera*, makes the record of the rumbling in the Lincoln, Nebraska, area of considerable interest

The record sheets of the automatic pressure recorders for the 28-mile pipeline from Ashland to Lincoln, Nebraska, which supplies water from the city of Lincoln, indicated abnormal and peculiar pressure variations during the earthquake

As far as known, the greatest intensity seems to have been noted at Falls City, Lincoln and to a less degree at Omaha, Nebraska, and at St Joseph, Missouri

The writer is in complete agreement with other geologists and seismologists that the tremors were caused by a slight slip along the old fault which delimits the east side of the buried Nemaha mountains The Nemaha mountain ridge is a faulted ridge of pre Cambrian rock, for the most part Sioux quartzite, which extends from north to south under eastern Nebraska and Kansas It has been described and discussed recently by the writer[1] in connection with the pre Pennsylvanian structure and stratigraphy of Nebraska

The top of the escarpment of this buried pre Cambrian mountain ridge stands about 1,500 feet above the downfaulted basin east of the fault at Nehawka, Nebraska, and it is more than 3,100 feet high in the vicinity of Du Bois, Nebraska at the Nebraska Kansas state line This entire mountain range is completely buried under Paleozoic and younger sedimentary formations The highest point on the ridge in Nebraska is at Du Bois, where it comes to 558 feet below the surface It rises about 100 feet higher a few miles south in Kansas The crest is buried under 1,567 feet of Paleozoic sedimentary formations at Nehawka, and under 1 870 feet of strata at Papillion, Nebraska

The Nemaha ridge is believed first to have come into existence by folding and faulting during the orogeny which brought the Proterozoic era to a close, that is, during the disturbance which is commonly known as the Killarney Grand Canyon revolution The Nemaha mountains are thought to have been a spur from the Sioux Falls high," and there may even have been a structural as well as a generic connection between these ancient north mid continent structural features and the long and prominent Killarney mountains, which are supposed to have extended from Minnesota northeastward to the Atlantic

The first faulting is thought to have occurred at that time, but there is ample evidence that major displacements also took place subsequently during the Paleozoic era following the Ordovician, Silurian, Devonian (?), Mississippian and Permian periods Apparently the last major displacement took place during or at the close of the Permian period, for Permian formations are faulted with a throw of from 200 to 250 feet in the Humboldt fault in Richardson County The vertical displacement of the St Peter sandstone in the vicinity of Nehawka and Nebraska City is at least 1,000 feet, and of the pre Cambrian Sioux quartzite at least 1,500 feet The displacement of the older formations is no doubt much greater than this farther south along the ridge This indicates that the older formations have been further displaced at each later disturbance so that the throw on such formations as the St Peter has been cumulative during very long periods of geologic time

[1] A. L. Lugn, *Bull. Amer Assoc of Petrol Geol*, Vol 18, No 12, pp 1597–1631, December, 1934

The Nemaha ridge remained an island in the Paleozoic sea, or perhaps it was a chain of islands, while sediments were piling up around and against it The succeedingly younger systems of rock rest unconformably against the Sioux quartzite and granite by overlap However, as indicated above, this simple relationship has been complicated by several stages of pronounced faulting, in every case apparently along the same rift or fault zone, which first seems to have come into existence late in the pre Cambrian

There is no known evidence indicating that any important displacements have taken place along the Nemaha structure during the Mesozoic and Cenozoic eras. Several mild earthquakes have been experienced during the last hundred years in eastern Nebraska, all or most of them apparently related to this ancient Nemaha structure It is interesting and significant that this very ancient topographic and structural feature has to a large degree dominated the structural and depositional history of eastern Nebraska and Kansas, and adjacent areas since pre Cambrian time and that it apparently is not yet entirely static

It is evident, in view of the facts stated above that the region affected by the recent tremors in all probability will experience mild disturbances from time to time It is also possible but not very probable that it may sometime experience an earthquake of destructive intensity

The late John R Freeman[2] regarded the Great Plains, an area of some 600 000 square miles, as the safest from earthquake danger in the United States However, he thought it probable that this whole great region might experience one earthquake of destructive intensity in a century Such a "destructive" earthquake would pretty completely wreck things within an area of about 2,500 square miles, according to Freeman Thus, according to this probability such centers as Kansas City, St Joseph, Omaha or Lincoln or any other single area of 2,500 square miles in the entire Great Plains region as defined by Freeman might expect one "destructive" earthquake in 24 000 years

A L Lugn

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SYNCHRONOUS FLASHING OF FIREFLIES EXPERIMENTALLY INDUCED

Eighteen previous notes in Science concerning synchronous flashing of fireflies attest the wide interest accorded this remarkable phenomenon It has been observed in the Philippines by Purssell[1] and F Morse[2], in Siam by Reinking[3] and Morrison[4], and in this country by E S Morse,[5] Allard,[6] Hudson[7] and the Snyders[8] In addition to these first hand accounts there have appeared a considerable number of vicarious reports, such as those cited in the reviews of E S Morse[9] and Gudger,[10] and in the papers of Blair[11] E S Morse,[12] Van Vleck,[13] Howard[14] and Merril[15] In view of this large and varied mass of evidence from independent sources it seems to be well established that synchronous flashing of fireflies really occurs

Several suggestions to explain the phenomenon have been advanced McDermott,[16] Craig[17] and Gates[18] maintain that it is accidental However, the chances are enormously against this, for according to all accounts the synchronism involves large numbers of individuals Many formerly held that puffs of wind influence the insects alternately to expose and conceal their lights, but Allard, Morrison and the Snyders observed flashing in unison during "profound calm" Laurent[19] considers the phenomenon to be due to twitching eyelids of the observer (!) and Craig attributes it to illusion Wheeler[20] lays the maintenance of the rhythm to an "Einfuhlung" or "sympathy" in the insects The Snyders found that the flashing interval is inversely correlated with temperature, and maintain that synchronism is due to uniformity in temperature, moisture, light and air currents, but they suggest no mechanism whatsoever for getting different individuals into synchronism with each other, asserting that this is purely accidental Blair and Richmond[21] consider the rhythm to be due to alternate discharge and recovery of a battery like mechanism, and these observers, together with Newman[22] and Hudson, believe that the flash of a leader sets off the flashes of the rest which build up a synchronism This contention, and that of Wheeler, are opposed by Morrison, who points out that a "leader" could not be visible to all members of a large swarm, and that the synchronism once initiated does not proceed

[2] John R Freeman, "Earthquake Damage and Earthquake Insurance," McGraw Hill Book Company, Inc, New York and London 1932

[1] John V Purssell, *Scientific American*, 118 71 1918

[2] F Morse, Science, 48 418, 1918

[3] Otto A Reinking Science, 53 485 1921

[4] T F Morrison Science 69 400–401 1929

[5] Edward S Morse Science, 43 169 1916

[6] H A Allard Science 44 710 1916

[7] George H Hudson Science 48 573–574 1918

[8] Chas D and Aleida V tH Snyder, *Am Jour Physiol* 51 536–542 1920

[9] E S Morse Science 48 92–93 1918

[10] E W Gudger Science 50 188–190 1919

[11] K G Blair *Nature* 96 411–415 1915

[12] E S Morse, Science 44 387 388, 1916 49 163–164, 1924

[13] Hester L Van Vleck Science 59 379, 1924

[14] S Francis Howard, Science 70 556, 1929

[15] R H Merril Science 71 132, 1930

[16] F Alex McDermott Science 44 610 1916

[17] Wallace Craig, Science 44 784–786 1916

[18] Frank C Gates, Science 46 314, 1917

[19] Philip Laurent, Science 45 44 1917

[20] W M Wheeler, Science, 45 189 190, 1917

[21] C A Richmond, Science, 71 537–538, 1930

[22] H H Newman, Science, 45 44, 1917

in waves from one or more sources, as maintained by both Allard and Hudson.

It is evident that none of these various notions provides a satisfactory explanation of synchronous flashing. It is the purpose of this paper to present experimental evidence that has a direct bearing on this problem.

Osten Sacken,[23] McDermott[24] and Mast[25] have studied the mating habits of a number of native species of firefly. In *Photinus pyralis* the male flies about emitting a single short flash about every 5.7 seconds. The female remains in the grass and responds to some nearby male by flashing shortly after each of his flashes. This exchange of signals continues until the male reaches the female and copulates with her. The above investigators did not ascertain how the male distinguishes between the flash of the female and that of another male, but the writer demonstrated conclusively (forthcoming publication) that no possible difference in the light of the two sexes is operative in this discrimination, and that the essential factor involved is the fact that the female (who flashes only in response to the flash of the male) invariably maintains the period of about 2.1 seconds at which she replies to each flash of the male. A striking feature of this "attraction," observed many times by the writer, is that whereas the exchange of signals is initiated by a single pair of insects, other males within range of the female (10 feet) often join in also, so that at times as many as 5 males may fly simultaneously toward the same female and that under these conditions all these males flash in unison.

Here, obviously, there is some mechanism other than chance which induces males originally out of phase with each other and flashing with different periodicities to break their ordinary rhythms and readjust them to that of the particular male which first responds to the female. The writer has often observed this readjustment of flashing in the field, but the factors involved therein still remain, in spite of considerable investigation obscure. At any rate the process results in several males responding simultaneously to the same female, whereupon (since their flashing periods are nearly equal) they necessarily flash in unison. Thus it appears that synchronous flashing on a small scale occurs regularly in nature as a normal preliminary to mating.

Precisely the same response on a larger scale can readily be induced by selecting a male, and in proper imitation of the female, flashing a flashlight 2.1 seconds after each of his flashes. In a well populated region the writer, in this way, has many times attracted from 15 to 20 males simultaneously to the flashlight. It is indeed an impressive sight to see such a group converging through the air toward one point, each member poising, flashing and surging forward in short advances, all in the most perfect synchronism. This extension of the normal phenomenon to a larger number of males is clearly due to the greater intensity of the light produced by the flashlight as compared with that produced by the female.

The facts presented indicate that the observed flashing in unison of large numbers of specimens distributed over a large area is probably produced as follows. A little group of synchronously responding males built up around one female, as described above, acts as a unit in stimulating another female a considerable distance away because the combined intensity of the several simultaneous flashes is greater than that of a single flash, the second female, then, in responding to the first group of males, gathers in to herself a coterie of males which flash in unison and are, of course, synchronized with the original group, they in turn stimulate a third female which "attracts" a third cluster of males, also synchronized with the original, and so on, until a large number of fireflies scattered over an extensive area are flashing in unison. The whole process thus depends on the fact that all the females reply to each of the flashes of the male at the same definite interval.

Several reports (Allard, Hudson, the Snyders, etc.) indicate that the apparent rarity of the phenomenon in large numbers of fireflies is due to the fact that it only occurs under special environmental conditions, such as calm, unusual humidity and darkness, and a large open space crowded with the insects. This fact supports the interpretation presented above, as such conditions would be favorable to the spread of synchronism from group to group, in the manner suggested. The flashing in unison, once established, would probably continue, owing to the normal rhythmic flashing period of the male, until terminated either by some environmental disturbance, such as a breeze (which does actually interfere with the regularity of flashing of the male), or, since luminosity ceases with copulation, by exhaustion of the evening's supply of responding unfertilized females.

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[23] Baron Osten Sacken, *Stettiner Ent. Zeitung*, 22: 54, 1861.

[24] F. Alex. McDermott, *Canadian Entomologist*, 42: 357–363, 1910; 43: 399–406, 1911; 44: 73, 309–311, 1912; 49: 53–61, 1917.

[25] S. O. Mast, *Jour. Animal Behavior*, 2: 256–272, 1912.

TREE RINGS IN NEW ENGLAND

IN the course of an attempt to determine how well the annual rings of wood in a tree reflect climatic influences in New England, some hemlock tree stumps

at Wolfeboro, N H, have been found to reveal a logging operation between the growing seasons of 1794 and 1795 The evidence for it appears in the sudden "release" of the then small hemlocks, as shown by the change from suppressed growth and very narrow rings to normal growth and broad rings after 1794

Although such evidence of release of young trees by removal or death of much larger trees is commonplace to students of forestry, it is thought that the observations here recorded form something of a record in that they date an event in the eighteenth century A total of 129 annual rings had been formed under the new conditions by each of the six trees chosen at random from about ten times as many cut early in 1924 This precise agreement showed that the release was not due to natural causes but to an act of man, and the history of the site confirmed the idea because it was then adjacent to the cultivated land on the well known estate of John Wentworth, provincial governor of New Hampshire From our analyses of other hemlocks on other sites, the release of individual young trees is evident, but, even though growing within a few rods of each other, their sudden increases in rate of growth occur in different years

It is also possible to make a preliminary announcement that this study of climatic effects on growth rates of the hemlock, *Tsuga canadensis*, has produced positive evidence in favor of a marked control of growth by rainfall *during the growing season* Drouth years in particular are marked by narrow rings, while seasons with abundant rainfall usually give relatively wide rings Since the trees used for analysis have as many as 335 rings of wood, the results should add to our knowledge of rainfall in New England well back into the seventeenth century

This work is being supported in part by a grant from the American Association for the Advancement of Science, and a detailed report of it will appear later In the meantime, information concerning old growth hemlock stumps and butt logs in New England (with known dates of cutting) will be welcomed as an aid to the collection of accurate data from widely separated sites in the area

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NATIONAL WELFARE, BUSINESS PROFITS AND INDIVIDUAL BENEFIT

IN an admirable article in SCIENCE (Vol 81, No 2090, January 18, 1935, pages 55–62), Professor Wesley Mitchell has presented what may eventually be considered the definitive case for national planning Although he has neglected the vital distinction between an *oligarchic* "planned" society and a co-operative or *democratic* "planning" society, Professor Mitchell has, I think, demonstrated the inevitability of some kind of large scale social planning By whom and for whose good the planning shall be done now becomes the crucial issue

I am, however, concerned by Professor Mitchell's apparent retention of an outworn theory of motivation as the psychological basis for economic behavior He states that the '*application* [of scientific discoveries] has been effected *mainly* by men who were seeking profits" By implication, these fundamental discoveries themselves were *not* made because of the driving power of the profit motive Granted that capitalistic enterprise since the industrial revolution may be equated with the 'profit system," it is a defective picture of human nature to assert that even the work of the competitive business world has ever been *mainly* performed under the incentive of profits At least 95 per cent of the people (in which I would include most of the readers of SCIENCE) make no 'profits" in the technical meaning of the term as the positive difference between sales price and cost of production, including administrative salaries They do, however, secure personal 'benefits" and 'advantages," *i e*, individual 'gains," which are an altogether different matter Human needs demand gratification, but the "need' for profits is a feeble acquired want in most men The mere existence of technicians and professors who are gratified by an elevation in rank with an accompanying drop in compensation (not a rare combination in recent years!) is sufficient refutation of the strength of the "profit" urge among applied scientists Certainly industrial psychology and personnel management would be non existent fields if the lure of an excess monetary reward were the only, or even the principal, factor making for cultural advance

Economists, executives and advertisers are keenly aware of the reality of "non financial" incentives It is, therefore, all the more strange that in philosophizing about the present social order, so many of them make such an inadequate and false distribution of emphasis in cataloging the motives underlying their own activities

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CHINESE MAGIC MIRRORS

A RECENT news item in the *Herald Tribune* of New York was to the effect that certain scientists had started an investigation as to how the Chinese magic mirrors were constructed This interested me very much, for I recall how the late physicist, Dr Thomas Corwin Mendenhall, with whom I was associated on the board of trustees of The Ohio State University, had become interested in the same question while teaching in Japan, how he had discovered

the secret of such magic mirrors then accidentally made, and how he had demonstrated their manufacture as a possibility In honor of this discovery the university annual published by the students of Ohio University was called *Makio,* which, I am told, is Japanese for magic mirror

JOHN KAISER

MARIETTA OHIO

SCIENTIFIC APPARATUS AND LABORATORY METHODS

HIGH ROTATIONAL SPEEDS IN VACUO

THE need for some simple inexpensive method of producing high rotational speeds in vacuo has frequently been felt in many fields of experimental science The air driven ultracentrifuge has been adapted to supply such a demand A brief description of its basic features may prove of value

The rotating member consists of three main parts (1) a small conical air driven air supported turbine [1] (2) a much larger and heavier rotor of any desired shape which spins in the vacuum chamber (3) a steel piano wire extending vertically downward along the axis of rotation from the vertex of the turbine above the vacuum chamber to the larger rotor which it supports and drives A cross sectional view of the rotating member the turbine stator and the cylindrically shaped vacuum chamber is given in Fig 1 The wire enters the chamber through a special type of brass gland with two holes that leave very slight clearances Viscous oil slowly forced by a gravity feed into these clearances both lubricates the gland and serves to make it vacuum tight This lubrication and the small diameter of the wire reduce friction losses to a negligible amount

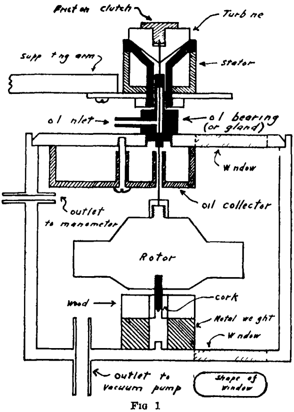

FIG 1

[1] See Beams Weed and Pickels SCIENCE 78 338 1933 *Journal of Chemical Physics* 2 143 1934

To prevent sudden accelerations or decelerations from excessively twisting the wire it is not fastened to the turbine proper but passes through a small hole along its axis and is clamped to a friction clutch The stator is supported by three arms made of light, stiff strips of channel brass each flexibly mounted and about 6 inches in length They are provided with ample adjustment for centering, raising or lowering the stator Fastened to the top inside the vacuum chamber is a circular cup like container to collect any oil leaking from the gland A very small disk (not shown in the drawing) attached to the wire just below the gland will throw this oil into the collector and prevent its reaching and clouding any windows in the apparatus Below the rotor is a circular block composed of metal wood and cork and arranged as shown in the figure The rotor is supplied with a steel tip fitting loosely enough into the cork for friction to be negligible The block is free to move about on the floor of the chamber within a limited range so that it will automatically settle into the correct position when the rotor is spinning It is heavy enough, however to prevent undesired precessions from being set up by the rotor

The rotor becomes vibrationless soon after the turbine is started and the air pressure has been raised sufficiently to support it It might be noted that great precision in machining and balancing the rotor is not essential as was well attested by the smoothness with which a 3 inch steel rotor spun after having a ¼ inch hole drilled near the periphery An air turbine weighing less than 50 grams will rotate an 800 gram rotor at a speed just slightly less than that of the turbine alone The unguided sections of the wire are not long enough to permit objectionable standing waves being set up The vacuum obtainable is apparently limited only by the slight vapor pressure of the oil Oil consumption in the gland amounts to less than 1 cc per hour In stopping the rotor, wear on the turbine and stator can be minimized by lowering the stator and allowing the rotor to drag on the wooden block below it Windows are conveniently

arranged for observing or photographing any desired operations

Reference has already been made to articles describing the construction of the air turbine Some dimensions used in a typical apparatus include diameter of wire, 0 5 mm, stator of 8 holes made with a No 60 drill, 3 cm steel turbine with 30 flutings, 9 cm duralumin rotor weighing 450 grams and shaped as shown in the drawing, brass vacuum chamber 5½ inches in diameter, 4¾ inches in height and wall thickness of ¼ inch

The rotational speed is limited only by the strength of materials The rotor just described exploded when the speed reached a little above 2,200 revolutions per second At this speed approximately 12 cubic feet of air per minute (as measured at atmospheric pressure, room temperature) were being supplied to the turbine at a pressure of 70 lbs/in² The maximum centrifugal force was approximately 900,000 times gravity The linear speed at the periphery was over 2,000 feet per second or nearly twice the velocity of sound in air The kinetic energy of rotation was approximately $3\ 7 \times 10^{11}$ ergs, which corresponds to about 8,800 calories

The method described offers numerous advantages and opportunities for research The apparatus is simple and inexpensive to build and to operate Where compressed air is not available, it should be well adapted for operation with other gases or perhaps steam, since the main rotor and the driving mechanism can be easily thermally isolated and controlled Also slower types of motors could be substituted for driving the rotor if necessary The flexibility of the wire makes possible an extremely smooth and even rotary motion not usually obtainable otherwise This, coupled with the fact that the rotation takes place in vacuo, makes the apparatus highly suitable for the centrifuging of solutions and suspensions, especially where the particles separate so slowly that convection currents in the liquid are apt to give trouble The poor results of many high speed centrifuge experiments can often be traced to very slight temperature gradients within the rotor which have been introduced through friction or some other external source The new arrangement allows a considerable increase in both the capacity and the speed of an air driven centrifuge

In view of the foregoing facts, we believe the apparatus affords not only a most efficient centrifuge, but a means of investigating many different phenomena.

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J W Beams

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A NEW METHOD OF DIFFERENTIATION OF AMYLASES AND STARCHES

In a communication in Science for October 5, 1934, p 317, Grace E Pickford and Frances Dorris have described a micro method for the detection of proteases and amylases In this connection it may be of interest to point out that the same method has been developed by the present writer for characterization of different amylases occurring in plant and animal, and that the results of the investigation have already been published in the *Journal of the Indian Institute of Science*[1]

This method has been extended for the differentiation of various starches In the course of an investigation on the hydrolysis of different starches by amylases, it was found that the color reactions produced with iodine by the different starches in the course of hydrolysis differ markedly with the kind of starch and also with the concentration of iodine used These differences in colors obtained with iodine are made use of in the present method Agar plates impregnated with starch were prepared by mixing equal parts of hot solutions of agar and starch so that the total concentrations were 1 and 0 2 per cent, respectively, the resultant mixture being spread on a petri dish and allowed to set A drop of the amylase solution was then added to the agar plate and allowed to diffuse at the laboratory temperature for about 24 hours At the end of the period, the starch agar plate was stained with dilute iodine solution (N/100) and the colored zones obtained were observed The color zones produced differ with different starches and also with the type of amylase used

In Table I the color zones obtained by different

TABLE I

Starch	Color zones	
	Taka diastase	Salivary amylase
Potato	Light green zone surrounded by a violet ring	Colorless zone
Sweet potato	" " "	" "
Rice	Blue zone surrounded by a violet ring	Narrower blue zone
Maize	Central violet zone with a bluish violet zone surrounded by a violet ring	Violet zone
Wheat	" " " " "	" "

[1] K Venkata Giri, *Jour Indian Inst Sci*, 17A 127, 1934

starches by using taka diastase and salivary amylase have been described

The amylases used in the present investigation were taka diastase, 0 5 per cent (Parke, Davis and Company) and salivary amylase (human saliva centrifuged and diluted 10 times)

From the data given in Table I, which is only a rough indication of the color zones obtained with several starches, it can be seen that tuber starches can be easily differentiated from those of cereals, as the latter give deeper and more differently colored zones than those of tubers Amongst cereal starches wheat and maize give violet colored zones Thus the method affords an easy way of identifying the common starches adulterated in foodstuffs, particularly when the starch is cooked and its structure destroyed, in which case there is no method available in literature for its identification With the help of a colored chart prepared by the analyst for a number of starches it is possible to identify the individual varieties, whether cooked or otherwise, in which latter case the method is a good supplement to the conventional microscopic method

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SPECIAL ARTICLES

THE SIGNIFICANCE OF THE PERSISTENCE OF THE CRYSTALLINE STATE ABOVE THE MELTING POINT[1]

THE purpose of this paper is to show that the application of Boltzman's law allows the original objectives of van der Waals to be more effectively pursued Additional g\`\` ns in our understanding of liquids are also made thereby The process of vaporization may be readily visualized on the basis of kinetic theory and by this means Trouton s rule is readily derived This holds approximately for liquids except those boiling at very low temperatures One is accustomed to regard the process of fusion as one formally similar to evaporation, each representing a kinetic exchange process across an interface at which an amount of energy is given up by or imparted to molecules crossing the interface One might expect therefore that a Trouton s rule might govern the melting point For 'monatomic' substances, there is a rough approximation to this but it is not even approximately true for more complex substances The explanation of tl ese facts must be that in the process of fusion molecules do not pass over into a state which remains unchanged with increase in temperature until the boiling point is reached, but that the process of fusion represents but a partial breakdown of the crystal line structure The failure of the van der Waals equation arose from the application of the misconception that molecular forces are of long range, instead of very short range forces as we now know them to be De Bye and Keesom by applying the idea of short range forces and the well established Boltzman equation, obtained the expression

$$\overline{U}_\rho - \frac{N_A^2}{V}\int \varepsilon(r)e^{-\frac{\varepsilon(r)}{kT}}\, dV$$

for the average energy added to the internal energy of a gas containing N_A molecules in volume V, $\varepsilon(r)$ being the potential energy of two molecules at distance r apart. k is the Boltzman constant (See Herzfeld's chapter on imperfect gases and the liquid state in Taylor's "Treatise on Physical Chemistry," 2nd edition van Nostrand Company, 1931) This equation reduces to that of van der Waals at high temperatures It is equivalent to the precise equation of state of Onnes This treatment accounts for deviations from the perfect gas law, not through long range forces, but through the formation of clusters of molecules In 1923 C V Raman (*Nature* pp 428, 532, 1923) utilized a similar idea to account for the viscosities and the temperature coefficient of the viscosities of liquids,

$$\eta_{liq} - \eta_{vap}\, e^{\frac{F}{RT}}$$

where η_{liq} is the viscosity coefficient of the liquid, η_{vap} is that of the vapor and F is the heat of fusion The perfection of the fit of this equation is very striking for most liquids of not too great complexity However, the supposition that the energy term F is to be identified with the heat of fusion for all substances is not borne out, and fr\`m the foregoing discussion of the process of fusion, this is not surprising and does not condemn the more fundamental elements of Raman's theory Furthermore η should be the viscosity of the ideal liquid rather than of the vapor A large amount of evidence has been accumulating from other quarters to support Raman's concept of the nature of a liquid, which may be consolidated with the present uniform view of the organization of matter This evidence was reviewed in the 1933 discussion of the Faraday Society on "Liquid Crystals and Anisotropic Melts" There should be mentioned (a) The x ray investigations of G W Stewart, which led him to believe that ordinary liquids consist chiefly of orderly arranged aggregates of molecules but also in part of molecules having a much more random distribution (b) The work of Ornstein and his collaborators, who arrived at a similar view of the structure of liquids through investigations of dielectric losses, measurements of dielectric constants in magnetic fields and x ray investigations of liquids in electric and magnetic fields (c) And that of Bernal and Fowler (*Jour Chem Physics*, I, 515, 1933) on the nature of water Diffusion coefficients and viscosity coefficients of liquids are related to each other in a reciprocal fashion in accordance with the Einstein

[1] Read before the National Academy of Sciences, Cleveland, November, 1934

Sutherland relation (Einstein, *Zeits Elektrochem*, 14 235, 1908) $D = \frac{RT}{6\pi\eta rN}$ (η is the viscosity of the solvent and r is the radius of the solute molecules), whereas in the gas phase the two coefficients are proportional to each other, being related by the equation $D \frac{\eta}{\rho}$ (Loeb, "Kinetic Theory of Gases," p 224, McGraw Hill Book Co, 1923) The former relation assumes the validity of Stoke's law, which is valid for large spheres but for small molecules could not be justified on a kinetic conception of viscosity analogous to that for gases This should at once suggest that new kinetic factors prevail in the liquid phase It is apparent that the micro crystals which augment viscosity in proportion to the fraction of the volume which they occupy will hinder diffusion to a corresponding degree and thus account for the reciprocal relation The concept of micro crystals should shed its light upon other properties of liquids Thus their resolution into single molecules with increasing temperature would add a term to the specific heat expression for a liquid The measured compressibility of a liquid is a composite of the compressibility of the liquid and microcrystalline portions The micro crystals in liquid surfaces offer centers for catalytic action which would not have been suspected without them These questions have not been developed sufficiently for presentation

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THE ETIOLOGY OF EPIDEMIC COLDS IN CHICKENS*

DeBlieck[1] was the first scientist to report on the cause of colds in the chicken This investigator discovered a hemophilic bacterium which appeared to be involved in the disease in Holland The first American investigator to report on a similar disease was Nelson[2] This worker found a Gram negative bacterium which appeared to be responsible for the outbreaks investigated The chickens affected with this disease did not appear sick, and there was no mortality Production was seriously affected, and some of the birds showed a bilateral discharge, while distinct gurgling sounds were heard in the trachea At necropsy considerable exudate was found in the nasal passages, the infraorbital sinuses and the trachea The disease was transmitted to healthy birds by fresh tracheal exudate from diseased birds and by a hemophilic bacterium isolated from the exudate on culture media

Delaplane and Stewart,[3] working independently and at the same time as DeBlieck and Nelson, found a Gram negative hemophilic bacterium which they considered to be the cause of a serious outbreak in Rhode Island The symptoms were those of an exudative rhinitis and sinusitis with little involvement of the larynx, trachea or bronchial tubes The eyes, turbinates and infraorbital sinuses showed various degrees of inflammation The mortality in the Rhode Island outbreaks was comparatively high

Lewis and Mueller[4] report a series of experiments which lead them to believe that the agent of the 'common cold" in chickens is not a filtrable virus, and further work by Eliot and Lewis[5] indicates that a pleomorphic, hemophilic, Gram negative bacterium is the responsible agent They suggest the name *Hemophilus gallinarum* for the microorganism In their filtration experiments Lewis and Mueller used Berkefeld, Mandler, Chamberland and Seitz filters with negative results

Six widely separated outbreaks of coryza or colds in chickens have been studied in Massachusetts, using both bacteriological and filtrable virus methods Five of these outbreaks presented symptoms similar to those described by Nelson, and one in a flock of game birds was like that described by Delaplane and Stewart A hemophilic streptococcus was isolated from one,[6] a hemophilic bacterium from three[7] and no pathogenic microorganisms could be found by cultural methods in two of these outbreaks Filtrable agents were not demonstrated in any of these cases when Berkefeld, Coors and Seitz filters were used These findings are in agreement with those of De Blieck, Nelson, Delaplane and Stewart, in that Gram negative, hemophilic microorganisms may be present in colds of chickens and aggravate the symptoms and lesions of the diseases, as well as taking some part in immunity

Tracheal exudates from the two outbreaks in which hemophilic microorganisms could not be isolated were studied by means of a series of graded acetic collodion filters prepared according to the directions of Cox and Hyde[8] The causative agent passed successfully through these filters, and was transmitted directly to healthy chickens by intranasal and intratracheal inoculation of bacterial free filtrates The outbreaks from which the hemophilic microorganisms were isolated occurred before the series of graded acetic collodion filters were used in this laboratory and were not tested by this method

Since there is no satisfactory standard for measuring the size of the pores in the filters used in this

* Contribution No 214, Massachusetts Agricultural Experiment Station, Amherst, Mass

1 L DeBlieck, *Vet Jour*, 88 9, 13, 1932

2 J B Nelson, *Jour Exp Med*, 58 289, 304, 1933

3 J P Delaplane and H O Stewart, *R I State Coll Bul*, 29 92, 94, 1934

4 M R Lewis and E Mueller, *Jour Am Vet Med Assn*, 37 759, 769 1934

5 C P Eliot and M R Lewis, *Jour Am Vet Med Assn*, 37 878, 888, 1934

6 C S Gibbs, *Poultry Sci*, 12 46, 48, 1933

7 C S Gibbs *Mass Agr Exp Sta Bul*, 311 15, 1934

8 H R Cox and R R Hyde, *Am Jour Hyg*, 16: 667, 728, 1932

experiment, the size of the coryza virus particles can only be compared with particles of known dimensions which were treated in a duplicate series of filters at the same time and under the same conditions as the tracheal exudates from the chickens This experiment indicates that the coryza virus particle is smaller than *S marcescens* 0 5 by 1 0 μ Bergey,[9] and larger than the carbon monoxide hemoglobin molecule which has been determined by Northrop and Anson[10] and Svedberg[11] to be about 5 m μ in diameter Svedberg also found the ovalbumin molecule to possess a diameter of 4 34 m μ Using these values in connection with Poiseuille's law for determining the radius of the pores in permeable membranes, it has been found that the coryza virus particles pass through acetic cellodion filters with pores of an estimated diameter of 120 m μ, and are retained by those possessing a calculated pore size of 80 m μ Therefore, the diameter of the coryza virus particles must be between 80 and 120 m μ In general this finding is in line with the observations of Bauer and Hughes[11] and Elford,[12] who state that a relatively large group of virus particles has an end point within these limits

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[9] D H Bergey, Textbook, 3rd ed 116, 117, 1930

[10] J H Northrop and L M Anson, *Jour Gen. Physiol*, 12 543, 554, 1929

[11] T Svedberg, Kolloid 2, 51 10, 1930, quoted by J H Bauer and T P Hughes, *Jour of Gen Physiol*, 18: 161, 162, 1934

[12] W J Elford, *Proc Roy Soc London* Series B, 109, 360, 1931

THE HEART RATE IN HEAVY WATER

HEAVY water should afford a new method of controlling the rate of physiological processes We have found that the frequency of pulsation of the excised heart of the frog can be slowed down in 20 per cent D_2O

The heart of a winter frog was carefully excised, including the *sinus venosus*, and the base tied to a small glass rod A fine wire hook was inserted in the apex and attached to a heart lever writing on a kymograph The heart was immersed in a 2 cc of Ringer's fluid containing approximately 20 per cent heavy water in a small shell vial The room temperature was 18–20° C

The first heart tested was slit in the ventricle to facilitate diffusion, but this treatment rendered the beat rather feeble After 15 minutes in ordinary Ringer the time for ten beats was 11 3 secs The vial of D_2O Ringer was then substituted for the control, and the time for ten beats became 16 9 secs after 5 minutes The second heart tested was not slit and beat more vigorously After 6 minutes in H_2O Ringer the time for ten beats was 11 5 secs It was then immersed in the D_2O Ringer and after 10 minutes the time for ten beats was 27 8 secs It was then transferred to ordinary Ringer and the time for ten beats was reduced to 20 secs The third heart tested was placed immediately in the Ringer containing heavy water and after 5 minutes it was beating vigorously once a minute Seven minutes after immersion the beat was constant at a rate of once every 5 secs After transfer to H_2O Ringer the heart gave a regular beat every 2 secs After 10 minutes of this constant rate the heart was replaced in D_2O Ringer in which the pulsations occurred every 3 secs for 1 minute and then stopped However, the heart partially recovered when replaced in H_2O Ringer after 7 mins, the rate being once every 2 5 secs in regular sequence, except for a regular pause every 6 to 8 beats

Although the scarcity of the heavy water precludes extensive tests at the present time, the slowing down was twice reversed in the third heart, indicating the influence of the heavy hydrogen isotope

A similar effect has been observed by Mr H Z Gaw[1] in the rate of contraction of the vacuole in a race of *Paramecium caudatum* in 30 per cent D_2O, in which the vacuole empties every 19 secs compared to every 11 3 secs in controls (Temp 18 8° C) The slowing of the vacuole is completely reversible after return to ordinary water and it is probable that complete recovery of the heart would occur under conditions of normal circulation In each case the heavy water has an effect similar to that produced by lowering the temperature The biological effects of heavy water are what one would expect from the lower energy content[2] of chemical systems involving deuterium

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[1] T C Barnes and H Z Gaw, *Jour Am Chem Soc* (in press)

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SCIENCE

VOL 81 FRIDAY, APRIL 12, 1935 No 2102

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster, Pa Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

THE GOVERNMENT'S RESPONSIBILITIES IN SCIENCE[1]

By Dr KARL T COMPTON

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THE range of opportunity in science in this country is so great and the extent to which the government should undertake responsibility in this field involves such complex considerations that it is perhaps rash to undertake a discussion of the problem Nevertheless, the problem is as important as it is complex and events of the last two years have conspired to focus on it the attention of several organized groups of scientists with the result that some aspects at least of the problem have been somewhat clarified I will attempt, therefore, to give a brief sketch of the problem of the government's present responsibilities in science, together with some suggestions as to ways in which these responsibilities may profitably be extended as they have been developed through discussions in the Science Advisory Board and in conferences with many other agencies and individuals

[1] Address given on March 16 at the initiation banquet of the Yale Chapter of Sigma Xi.

My own contact with this study dated from a radiogram from my assistant, received in the summer of 1933 while on the boat from Boston to Bangor, stating 'Word received that you have been appointed chairman of committee to reorganize Federal Government" Realizing that there was some major misunderstanding, I was naturally interested to learn what had really happened and found in the paper on the following day that the President had appointed a Science Advisory Board of scientists and engineers with authority 'to appoint committees to deal with specific problems in the various departments"

This board now consists of fifteen men, including Dr Campbell, president of the National Academy of Sciences, Dr Bowman, chairman of the National Research Council, Dr Dunn, president of the J G White Engineering Corporation, Dr Jewett, president of the Bell Telephone Laboratories, Dr Kettering, president of the General Motors Research Corporation, Dr

Leith, professor of geology at the University of Wisconsin, Dr Merriam, president of the Carnegie Institution of Washington, Dr Millikan, director of the Norman Bridge Laboratory of Physics, California Institute of Technology, Dr Adams, professor of organic chemistry and president of the American Chemical Society, Dr Flexner director of the Rockefeller Institute for Medical Research, Dr Jones, professor of plant pathology at the University of Wisconsin, Dr Lillie, dean of the Division of the Biological Sciences of the University of Chicago, Dr Rosenau, professor of preventive medicine and hygiene at the Harvard Medical School and professor of epidemiology at the Harvard School of Public Health, Dr Parran, state commissioner of health of New York

I discuss the work of this Science Advisory Board with some hesitation on two grounds In the first place, your distinguished president, Dr Angell, is reported in the press to have raised a question as to whether the services to government by members of educational institutions may not sometimes be of less public value than their regular services in their institutions You have probably heard the remark attributed to President Nicholas Murray Butler in commenting on the large exodus of Columbia University professors to government posts "Columbia's loss is the nation's loss" In the second place, there are those who feel that the efforts of well meaning experts to assist the country, through their services to the government in these times of distress, have not all been well considered or successful Some of them are unfortunately analogous to the attempt to relieve the darky who had swallowed a potato bug by administering to him a large dose of Paris green to kill the potato bug

However these things may be, the Science Advisory Board has found certain directions of usefulness in a modest way, and through its consideration of problems of the scientific services of the government has formulated the broad outlines of a plan whereby the scientific forces of the country may be strengthened and put to work more effectively for the national welfare Before discussing this plan it will be helpful first to see where the government now fits into the picture of scientific activities of the country

The scientific services of the government are spread through forty federal bureaus, of which eighteen can be called primarily scientific Although their operations involve only about half of one per cent of the federal budget, their work is absolutely essential to the national welfare in agriculture, manufacture, commerce, health and safety

Typical problems in the administration of these bureaus are Is the organization adapted to the best fulfilment of its objectives? Are its objectives of distinct importance for the public welfare? Is its program planned with vision and keen appreciation of needs and opportunities? Are old projects dropped when their objectives have been attained? Is the personnel competent and alert? Is there proper coordination and cooperation with non governmental agencies? Are the most up to date methods in use? Is there unwise duplication of effort? Should a given project be handled by a governmental bureau or left to non governmental agencies? What is the best expert advice on a given problem of public interest?

Problems like these are always present and require constant attention if the government's scientific work is to be maintained on a plane of high efficiency Disinterested and competent advice is desired on occasions by the secretaries of departments, and similar advice and help are useful to the chiefs of bureaus.

The following three steps have been taken by the Federal Government to provide for itself disinterested and competent advice upon scientific matters

(1) The National Academy of Sciences was established by an Act of Incorporation "enacted by the Senate and House of Representatives of the United States of America in Congress assembled," and approved by President Lincoln on March 3, 1863, said act specifying that 'The Academy shall, whenever called upon by any Department of the Government, investigate, examine, experiment and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose," subject to the condition that "the Academy shall receive no compensation whatever for any service to the Government of the United States."

(2) The National Research Council was organized in 1916, at the request of President Wilson, by the National Academy of Sciences under its congressional charter, as a measure of national preparedness, and perpetuated by the National Academy of Sciences on April 29, 1919, at the President's further request, as expressed in Executive Order No 2859 The National Research Council is, in a sense, an operating arm of the National Academy of Sciences and is permanently organized into divisions, with representatives from all major scientific bodies, to further the interests of science and technology within and without the government

(3) The Science Advisory Board was created by President Roosevelt by Executive Order No 6238, July 31, 1933 (supplemented by Executive Order No 6725, May 28, 1934) "with authority, acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council, to appoint committees to deal with specific

problems in the various departments," with terms of appointment to expire on July 31, 1935

The appropriations for the scientific bureaus of the government have been greatly reduced since the affluent days just preceding the depression, by amounts ranging in some bureaus as high as 60 per cent According to Mr Ralph Ward the 1935 budget shows the following appropriations for scientific work

10 bureaus in the Department of Agriculture	$38,276,000
5 bureaus in the Department of Commerce	11,522,000
2 bureaus in the Department of Interior	1,232,000
8 bureaus in the Navy Department	3,918,000
1 bureau in the Treasury Department	9,313,000
6 bureaus in the War Department	4,503,000
Nat'l Advisory Com for Aeronautics	1,453,000
Smithsonian Institution	864,000

These figures include only expenditures for scientific work, except in the Department of Agriculture, where they include all appropriations to the bureaus, since it is difficult there to separate the scientific work from other activities

Taking the appropriations which go definitely for science, it is found that only about 3 of one per cent of the total budget of the Federal Government goes into scientific work In comparison with the importance of scientific work to the country, this is certainly not a large proportion One might well raise the question as to whether an increase in this amount might not bring advantages to the country which are large in comparison with those resulting from many of the other far larger expenditures

It is interesting to consider these expenditures against the total background of expenditures for scientific work in the country from all sources. Mr Watson Davis, editor of Science Service, has estimated the total national expenditure for work in science by government, industry, foundations and universities to be somewhat less than $100,000,000 per year It is seen, therefore, that the Federal Government accounts for roughly half of the total national expenditure for science

It is also interesting to consider the part played by the universities from the standpoint of expenditures for science The U S Office of Education Pamphlet No 58 gives the following statistics for the academic year 1934–1935 81 publicly controlled universities and colleges, with a total budget of $81,774,000, reported $9,526,000 as appropriated for research work The major portion of these appropriations were for agriculture Of the 81 institutions here listed only 47 reported any appropriations for research Of 219 privately controlled educational institutions with aggregate budgets of $57,600,000, practically all the research funds were reported by 16 of these institutions, and their aggregate expenditures for organized research were $1,627,000 It is evident from these figures that, important as research in educational institutions may be in developing new knowledge, their total expenditures for research are very much less than are the expenditures of the Federal Government for scientific work It must be remembered of course that most of the government's expenditures for scientific work are not for research but rather for the accumulation of scientific and technical data or the administration of technical services

It is of interest to note the part played by the philanthropic foundations in this whole program Dr Keppel, in an address at Brown University last year, stated that in 1931 the philanthropic foundations of the country distributed $54,000,000, of which about $10,000,000 were for encouragement of research, exclusive of the very important fields of medicine and public health Taking two of the largest of these foundations as examples, we note that the Carnegie Corporation in 1933 made grants of $68 000 for scientific research in the United States, and its scientific agency, the Carnegie Institution of Washington, reported total expenses of $1,576,000 Similarly, the Rockefeller Foundation in 1933, out of total appropriations and expenditures of $14,754,000, made appropriations of $4,509,000 for the natural and medical sciences and public health

It is of course extremely difficult to justify the accuracy of these figures because of the differences in manner of reporting, but certain general conclusions can safely be drawn The Federal Government is by a very large margin the largest scientific agency in the country The next largest single unit consists of the agricultural work of the land grant colleges and universities Excluding these the aggregate expenditures for scientific research by the universities of the country are comparable with the expenditures of the philanthropic foundations for these purposes (As stated above, these conclusions are necessarily very rough A major uncertainty lies in the definition of scientific work If the expenditures of universities for *educational* work in science had been included, their position would of course appear much more prominently in the financial comparison)

With this general background showing the distribution of scientific work in the country, let me now turn to a description of some typical problems of the federal scientific services which have engaged the attention of the Science Advisory Board and its committees during the past two years.

The first problem submitted to the board was a request by the Secretary of Agriculture for a study of the U S Weather Bureau and recommendations for improving its service There had long been recogni-

tion of economic and other advantages which would result if the accuracy of weather forecasting and of other meteorological data could be improved The issue may have been forced by a critical survey and report of the Weather Bureau by a committee of the American Society of Civil Engineers and by the disaster to the airship *Akron* The board's study of the Weather Bureau disclosed the enormous service to the public which this bureau has rendered per dollar of taxpayers' money which has gone into the service as a result of efficient organization and particularly because of the friendly contribution of services by an enormous number of voluntary meteorological observers organized by and cooperating with the Weather Bureau It was evident, however, that a new technique of weather forecasting, based on 'air mass analysis' and which originated in the Scandinavian countries, has proven to be superior to the older method now in use by the bureau which was based essentially on a systematic study of precedence in weather maps The air mass analysis method is a three dimensional rather than a two dimensional study of the atmosphere and therefore involves the use of meteorological data taken at high altitudes as well as those taken on the surface of the ground The atmosphere is like a huge ocean with cold currents coming down from the north, warm, humid currents flowing up from the region of the Caribbean, and a third current flowing in from the Pacific These currents are like great rivers or like the Gulf Stream, in the atmosphere, and follow more or less well defined but continuing varying paths over the country Storms and quick changes of temperature occur where they meet Tests on the Atlantic Coast by the Massachusetts Institute of Technology, and on the Pacific Coast by the California Institute of Technology and some years of use by the military services have demonstrated the improved accuracy of this new method While greater accuracy is valuable for all human activities which depend on the weather, and economically important, particularly in the handling and transportation of foodstuffs and live stock, it is the requirements of modern commercial aviation which have rendered acute the problem of greater accuracy in weather forecasting

We found that all the governmental agencies involved were anxious to cooperate in any movement which might improve the work of the Weather Bureau The Army and the Navy offered to assign some of their airplanes, used in practice flying for the purpose of taking up to high altitudes the self recording meteorological instruments needed to secure the data on temperature, pressure and humidity, and to do this at strategically located stations over the country The Bureau of Aeronautics in the Department of Commerce agreed to cooperate more closely with the Weather Bureau in unifying the communication system for transmitting meteorological data The board therefore recommended the adoption of the air mass analysis method of forecasting, together with other important improvements, such as increasing from two to three and if possible 4, the number of daily weather maps, the attaining of an increased amount of meteorological information from the region of the Caribbean Sea in which destructive hurricanes have their origin, and the closer inspection of meteorological stations

These recommendations have been adopted and are being put into effect as rapidly as circumstances permit The major difficulties to be overcome are, first, the retraining of personnel to use the new method, which will take a minimum of five years and which involves some knotty problems of internal administration, and second, some increase in the annual appropriations to the Weather Bureau, which can be unquestionably defended on the ground of large economic return to the country but which are difficult to obtain in these times of anxiety over federal expenditures and which have not yet been granted by Congress

Another great and essential scientific service of the Federal Government is the National Bureau of Standards through which are maintained those scientific and technical standards which form the very basis of modern manufacturing methods as well as of scientific and technical work generally A peculiarly acute problem faces the Bureau of Standards because of the following situation, which is over and above the problem of decreased budgets which has faced the scientific services generally

Because of the nature of the Bureau of Standards, it has been found to serve a useful purpose in setting the specifications for the purchase of all kinds of materials by federal agencies, such as army blankets, trucks for the Post Office Department, thermometers for the Veterans' Hospitals and thousands of similar items Having set these specifications, it is then necessary for the government to test its purchased materials to find out whether they meet the specifications, and here again the Bureau of Standards has been found the most convenient and in fact, the only government agency set up to make such tests Consequently, a very large portion of the work of the bureau has come to be the testing of purchased materials for other branches of the government, although this work was not contemplated or provided for in the organic act which created the bureau As a matter of fact, nearly half of the budget of the Bureau of Standards is required to carry on such work

When the severe reductions in appropriations to government bureaus were made for the purpose of balancing the federal budget, the total appropriations to the bureau were cut nearly 50 per cent. It was impossible, however, for the bureau to reduce its ex-

penditures for these government testing services because the government was continuing to purchase materials even on an increased scale. The fact that the bureau has had to continue this work undiminished has resulted in its crowding out of a large portion of the proper work of the bureau for which it was originally established and this work, as a matter of fact, has had to be reduced at least 70 per cent. The problem of the Bureau of Standards has therefore been one of the most severe of any of the federal bureaus.

Three agencies have combined to make a joint study of this situation, the Science Advisory Board, the Visiting Committee of the Bureau of Standards, which was set up by Act of Congress and the Committee of the Bureau of Standards of the Business Advisory and Planning Council of the Department of Commerce. This joint committee has made a detailed study of the activities and problems of the bureau and has recommended that certain activities be dropped, that others be transferred to non-governmental agencies where possible, that others be reduced for the time being and that still others be pushed forward and extended. Many of these recommendations have not been made because reduction or curtailment was desirable, but simply because curtailments *had* to be made somewhere because of the budget reduction.

The Secretary of the Interior asked the advice of the Science Advisory Board as to whether the Geological Survey and the Bureau of Mines should be combined or retained as separate bureaus. A study of the situation led to the recommendation that the bureaus should be maintained separately though with minor readjustments of functions. There were two primary reasons for this recommendation, one that the objective and methods of the two bureaus were quite different, and the other that it would be difficult if not impossible to find one director for the combined services who would be sufficiently acquainted and sympathetic with both of them to prevent one or the other suffering from lack of leadership. At the same time the study disclosed a woeful inadequacy of statistical information in regard to minerals generally, and this at a time when such information is most urgently needed for the administration of the codes, of regulation of production and of tariffs and reciprocal trade agreements. It was therefore recommended that the agencies charged with collecting mineral statistics, which were spread over four bureaus in different departments, should be consolidated into one bureau of mineral economics and statistics. I am glad to say that these recommendations also have been adopted.

The Federal Coordinator of Transportation requested the Science Advisory Board to appoint a committee to cooperate with a committee of railroad presidents, for the purpose of finding out whether the railroads are making as effective use as possible of modern scientific and technical developments and to formulate a plan whereby the railroads may make as effective use as possible of such developments. This joint committee of leading railroad presidents and distinguished directors of industrial research has rendered its report in which broad policies for guiding and coordinating research work for the railroads were laid down. The results of this report are being crystallized in the newly formed Division of Planning and Research of the Association of American Railroads. There is no doubt but that the opportunities here are great and that the railroads are disposed to make every effort to utilize modern technology as effectively as possible and it is perhaps fair to say that it is the human element in the situation, namely the difficulty in finding properly qualified men to take charge of this work, which will be the limiting factor in the rate at which this program will be made effective.

One of the possible cures for the depression which has frequently been suggested is the creation of new industries, and the Secretary of Commerce has requested his Business Advisory and Planning Council and the Science Advisory Board to cooperate in recommending to him a program to this end. The assignment is a difficult one, for new industries are like babies—they need shelter and nourishment, which they take in the form of patent protection, financing and chance of reasonable profits. But before all they need to be born, and their parents are science and invention. Neither laws nor committees nor juggling acts can perform the necessary first step of conception. Also, like babies, new industries require time for growth. It is therefore evident that consideration of this problem involves stimulation of scientific research and engineering development, requires opportunities for financing and for the making of profits, which are rendered somewhat difficult under some of the more recent legislation, and requires a degree of patent protection which is difficult under our present system which is staggering along and almost swamped by the complexity of modern developments in the patent fields of types which were not contemplated when the patent law was originally drawn.

To cope with this situation the Science Advisory Board is making certain recommendations of government assistance in the stimulation of scientific work generally, and is submitting recommendations for certain modifications in patent procedure which should greatly improve the present situation without changing the general structure of patents. Some of the situations which these recommendations are designed to meet are the following:

The load on the Patent Office, from the enormous number of applications to patent all things from the trivial to the important, is such that adequate examination of prior art is impossible For this reason the assurance of a patent does not now carry with it the proper validity and, in fact, I am told that over 65 per cent of all patents which come up for litigation are declared invalid by the courts The situation is so bad that it has come to be said that a patent is simply an invitation to sue

A second difficulty lies in the time and expense and doubtful outcome of patent litigation The expense has become so great that some large organizations are seriously questioning whether or not their research organizations are an economic gain or loss, and others are avoiding patents and seeking security in secrecy

A third difficulty lies in the complexity of modern inventions, whereby a single product may involve a large number of different patents often held by different individuals If any one of these individuals refuses to grant license under his patent, he may entirely block production of the product It is this situation which has forced organizations to seek to acquire complicated patent monopolies which in turn have not been looked upon with favor by the courts The situation is well nigh an impossible one in its present form

Through wide consultation and correspondence a general consensus of opinion has been found in support of certain remedies for these situations, and these will soon be submitted to the secretary as a partial answer to his request for a plan for the stimulation of new industries

One of the most far reaching services of the government is its work in surveying and mapping An accurate map of the United States is a prerequisite of all types of construction and planning The standard map of the United States is less than half completed, and until the work is finished millions of dollars will be wasted in temporary and uncoordinated surveys which are found necessary by municipalities or states or construction agencies to handle their particular jobs We are the only progressive nation in the world whose country has not been adequately surveyed and mapped

There are more than twenty bureaus in the government which have mapping activities The question has frequently been raised, "Should not these be consolidated?" This question has been investigated by the Science Advisory Board at the request of the Director of the Budget and a report with recommendations has been submitted to him Among the interesting considerations are the following

In some bureaus the production of maps is not a major objective, but maps are produced and used only as tools in the attainment of some other objective In the case of other bureaus, however, the sole purpose of the bureau is to produce maps As a basic principle it may be suggested that the tools should not be taken away from the people who need to use them In other words, the subsidiary mapping services should not be consolidated into a federal bureau On the other hand, a strong argument for efficiency can be made for the consolidation of those services whose sole objective is the production of maps This argument is based upon efficient use of personnel the year round, elimination of duplication and uniform adoption of the most modern and efficient methods On the other hand, there may be good reasons for the maintenance of separate units in several cases For example, in the military services, military necessity or secrecy or the maintenance of a staff under immediate military control may be important factors

This question has been frequently discussed by previous commissions and before Congress, and there are amusing illustrations of arguments pro and con which have been invented to impress Congress without adequate basis of fact From the standpoint of national efficiency it is highly important that some action should be taken, but any action which involves the transfer of established bureaus meets with a type of opposition which is politically difficult to overcome We very much hope that the present effort may meet with a degree of success which has been denied the more than a dozen previous efforts which have been made to effect an improvement in this field

It has been very difficult to secure an unbiased opinion regarding the economic possibilities of mineral development in the region of Boulder Dam with the utilization of the electric power there developed Perhaps because of the great industrial and political interests involved, the Science Advisory Board was called upon as a disinterested body to make a survey and report on this matter This work was carried out in three steps first, a factual survey by the Geological Survey of the extent, grade and accessibility of the mineral deposits within reach of electric power of the Boulder Dam, second, a determination of the cost of production of the various products obtainable from these mineral deposits, and third, a consideration of such economic features as transportation costs to the point of demand and the effect of such production on similar industries in other localities The result of this study has been the publication by the Department of the Interior of a factual analysis from which can be selected those products which can profitably be developed and those other products whose development at the present time would be economically impossible or undesirable in competition with other sources of supply

The Department of Agriculture carries on more scientific work than any of the other departments. This work is found in about ten out of the eighteen bureaus of the department. Many of these bureaus are almost independent organizations and there is a considerable amount of duplication of effort and of facilities. Some of this duplication is necessary to the efficient performance of work, while in other cases a more effective coordination would undoubtedly be advantageous. The Secretary of Agriculture requested the Science Advisory Board to give particular attention to the Bureau of Chemistry and Soils in its relation to the chemical work of other bureaus. It has sometimes been suggested that all chemical work of the government should be concentrated in one comprehensive bureau of chemistry. On the other hand it is pointed out that chemistry is frequently a tool which is needed by a worker in some other field where the objective is not primarily chemical in nature. It is obviously a very difficult matter to ascertain that most effective degree of consolidation or the best type of coordination of such work. A distinguished committee has been giving attention to this problem bringing in the benefit of the best industrial experience as well as expert knowledge of chemistry. This committee has found certain difficulties which are peculiar to the government organization and which probably preclude an ideal solution to the problem. In view, however, of the millions of dollars which are spent on research in this department, it is decidedly to the public interest to see that this work is being done with the maximum effectiveness, and the officials of the department are cooperating with the committee in an effort to find a solution which will be as nearly ideal as possible and at the same time practicable within the limitations of government operation.

These illustrations taken from the varied activities of the Science Advisory Board, will show something of the interest as well as the complexity of the government's work in the varied fields of science. Beyond these particular services attached to existing bureaus, there lies, however, an immense field of government responsibility in which science plays or may play a prominent part, and I would next comment briefly upon the opportunities and responsibilities which the government may have in this larger field.

There are important national problems like insanity, crime, public works, unemployment, excess agricultural production, land use and power utilization, which are of great concern to government but for which the responsibility extends beyond the jurisdiction of governmental bureaus to states, municipalities and to the people as a whole. They involve considerations of care, relief, control and management which are the subject of governmental action involving enormous expenditures. They are the concern of the social scientists in order that this care, relief, control and management may be wisely conceived and administered. But they should also be the concern of the natural scientists in two main aspects: first, to ascertain the facts which are susceptible of scientific observation or measurement, in order to supply social scientists and government with data essential to their activities; second, to alleviate or cure the difficulties where this is possible by applications of science, as illustrated below.

The magnitude of the purely economic aspect of these problems is realized by very few people. In the case of mental illness alone, approximately 20 per cent. of the state budgets goes to care of the mentally diseased. Past experience and present knowledge both indicate that science will probably succeed in alleviating or partially curing all these difficulties if given adequate time and opportunity. It is obviously in the public interest, therefore, that this opportunity should be given and that this should be done as rapidly as the scientists themselves are able to handle the opportunity. As an investment for the future, or an insurance against future expenditures, and at the same time as a social obligation the government has a great responsibility in seeing to it that work along these lines is pushed as vigorously as possible. The Science Advisory Board is prepared to cooperate with other agencies in pointing out this responsibility and urging that the government accept it.

If time permitted it would be possible to analyze these problems in greater detail and to submit specific programs for work in pure and applied science whose social value is unquestioned and which can be laid out with some degree of assurance on the basis of present knowledge. I would simply mention, by way of illustration, such matters as tropical diseases, long range weather forecasting, development of new and improved uses of electric power, discovery of new uses for agricultural products, elimination of specific hazards in navigation, etc.

It is interesting and somewhat disheartening to note that our country, with all its boasted progressiveness has paid less official attention to science as a means of combatting our present difficulties than any of the other great powers.

Russia, seeing what science has done in raising the standard of living in other countries—especially in our own country—is centering her whole economic program on science. She has used, as the central feature of this program, the Academy of Science, founded by Peter the Great. Under this have been established more than two hundred great research institutes for work in pure science and engineering. Her annual appropriations for these institutes are reported to be

larger than any other items in her budget—even the military and defense item[2] Many of her scientific laboratories rank among the best equipped laboratories in the world at the present time Though short of trained workers, they are already turning out some first class work, and a well-considered program of selecting and training research workers has been instituted

Great Britain also has taken decisive steps to utilize science for social and economic improvement, despite the fact that she was harder hit than we by the war, her unemployment crisis came sooner, her taxes are higher She has called her leading scientific men to advise her privy council on scientific and technical policies, through three advisory councils composed of Britain's most noted scientists It is on advice of these councils that the programs and budgets of the government's scientific bureaus are determined The government furthermore, appropriates about a million pounds annually, to be used for research On advice of the advisory council, appropriations are made to governmental scientific bureaus and grants for research are made to educational institutions and scientific societies also for research fellowships and for support of industrial research by trade associations, provided these associations match the grants with similar contributions from their own funds In this latter way, programs of research have been inaugurated in twenty one of the most important industrial associations

Italy has mobilized her research facilities in a broad scale effort to rehabilitate her economic position and to counteract her deficiency in raw materials through application of her "brain power" to the most effective use of what she has The government has appropriated large sums for the better equipment of university research laboratories and all work in these institutions and in governmental laboratories is supervised by a National Research Council Furthermore, no governmental financial assistance is given to industries unless this Research Council certifies that the industry maintains a progressive policy of research and development[3]

Until recently Germany led the world in her sustained efforts to maintain a strong economic position through scientific research, notably in the fields of chemistry and metallurgy Every one knows the success of this policy, until it was largely wrecked by other circumstances Her scientific strength, however, is still probably Germany's strongest economic asset

Japan, for years, has been bending every effort to introduce western technology into her industrial procedures. Begun as a policy of copying technical processes and products which had been developed elsewhere, it was accompanied by an intensive program of scientific education of her own scholars She is now in a position to lead as well as to follow in scientific work of high quality, and this is bearing fruit in her industrial position

Compare this picture with that of our own country As soon as we got into trouble we cut our governmental expenditures for scientific work *more* severely than those of any other government activity We gave no consideration either to unemployed scientists or to the public value of their work in our emergency measures for relief of unemployment or for economic rehabilitation And yet we have prided ourselves as being the most advanced nation on earth!

The truth is that we have been fortunate enough to have great natural resources, which we have exploited riotously, we have had a pioneering spirit which has bred some great inventors, this same pioneering spirit has developed some industrial giants who have plunged into big things and have brought "quantity production" into operation, we have been blessed with a few great philanthropists whose altruistic vision has led them generously to support scientific work and other activities for human welfare in universities and other private institutions But, as a people and therefore as reflected in our national policies, we have been more lucky than intelligent Now that we are no longer able to thrive on the unrestricted exploitation of the gifts of nature, it is imperative that we take steps to utilize our resources more intelligently and effectively, and this means scientific research on an increasing scale

In conclusion, it seems to me that what is needed is a bilateral program for putting science to work for the national welfare There is needed on the one side the cooperation of the scientists of the country generally, to assist the government in putting the work of its scientific bureaus on a scale of maximum efficiency and value There is needed on the other hand a new type of government leadership whereby the scientific men of the country may be brought together to make an intelligent and coordinated attack on the great problems which are facing the country at those points at which science may offer hope of alleviation or solution

Under these circumstances it seems to me certain that scientists will have to play an even more important rôle in the future than in the past. The problems to be solved are more complex, greater intelligence is

[2] Report by Dr Julius F Hecker, of Moscow University, who was sent to the United States to arrange for a system of exchange research professorships between the United States and the U S S R

[3] Report by Mr Maurice Holland, director of the Division of Engineering and Industrial Research of the National Research Council, following his recent study of conditions in Italy

needed in handling them, the scientific approach rather than the political or opportunistic approach is demanded Whether directly in the government service or indirectly in universities or industries of the country, there is no doubt but that men of the type found in the Society of Sigma Xi will find ample scope for their best efforts and in those efforts they will find careers of usefulness and of satisfaction

OBITUARY

JOHN JAMES RICKARD MACLEOD

JOHN JAMES RICKARD MACLEOD, M B , Ch B , D Sc (University of Toronto 1923, University of Pennsylvania 1928, Jefferson Medical College 1928), LL D (University of Aberdeen 1924 and Western Reserve 1928), D P H (Camb), F R S , F R S (Can), was a son of the manse, born at Cluny, near Dunkeld, Scotland, in 1876, a son of the Reverend Robert Macleod He was educated at Aberdeen Grammar School, Marischal College Aberdeen and Cambridge University

After a short period of postgraduate study on the Continent and in London, like many another Scot, he migrated to the United States At the early age of 27 years, he was appointed professor of physiology at Western Reserve University, Cleveland, Ohio

Here he established for himself a reputation as a teacher of physiology and an investigator in the field of carbohydrate metabolism, which attracted the attention of the authorities in Toronto In 1918 Professor Macleod was appointed to the chair of physiology at the University of Toronto, where he remained till 1927 He took a keen and deep interest in medical education and was instrumental in the establishment of the six year course in medicine at the university here

Soon, his laboratory attracted a group of young workers in physiology It was due to Professor Macleod's established reputation as an authority in carbohydrate metabolism that Dr Banting, now Sir Frederick, came to Toronto to consult him and to pursue his investigations on the pancreas with the assistance of C H Best, then a young assistant, who eventually succeeded Professor Macleod as professor of physiology at the University of Toronto These investigations led to the brilliant and important discovery of insulin by Dr Banting and Mr Best

With the aid of Dr J B Collip the first stages of purification of insulin were undertaken and arrangements made for its commercial production For the final purification, a large group of workers contributed, including Professor P A Shaffer, of Washington University, St Louis, and Professor J J Abel, of the Johns Hopkins University, Baltimore

In recognition of this very important discovery, Dr Banting and Professor Macleod were awarded jointly the Nobel Prize, the former sharing the award with Dr Best and the latter with Dr Collip

In 1927 Professor Macleod returned to his alma mater as Regius professor of physiology, an honor which he himself valued greatly At the time of his death he was chairman of the department of research in the Rowatt Institute of the University of Aberdeen

Many outstanding honors were accorded him from universities and scientific bodies in Canada, the United States and Great Britain, and he was the author of numerous books of physiology and biochemistry Among such honors was the fellowship of the Royal Society, presidency of the American Physiological Society in 1922, the Royal Canadian Institute in 1925, fellow of the Royal Society of Canada, honorary fellow of the Academy of Medicine, Toronto, foreign associate fellow of the College of Physicians of Philadelphia, and correspond ng member of the Medical Chirurgical Society of Bologne and of the K Deutsche Akad Natur Forscher zu Halle He was the winner of the Cameron Prize at the University of Edinburgh in 1923, and was a member of the American Physiological Society, the Society for Experimental Biology and Medicine, the Society of Biological Chemistry, the Association of American Physicians, the American Association for the Advancement of Science the London Physiological Society and the Biochemical Society

He is survived by his widow Mary McWalters He had no children

VELYIEN E HENDERSON

UNIVERSITY OF TORONTO

RECENT DEATHS

ERNEST B SKINNER, professor emeritus of mathematics, for forty two years a member of the faculty of the University of Wisconsin, died on April 3 He was seventy one years old

PROFESSOR THOMAS CRAMER HOPKINS, until his retirement in 1931 head of the department of geology at Syracuse University for thirty one years, died on April 3 at seventy three years of age

Nature reports the death of Dr B M Wilson, professor of mathematics in University College, Dundee, formerly lecturer in pure mathematics in the University of Liverpool, on March 18 at the age of thirty eight years, and of Major General Sir Richard M Ruck, of the Royal Engineers, known for his scientific work in submarine mining and chairman of the council of the Royal Aeronautical Society from 1912 to 1919, on March 18, aged eighty-three years

SCIENTIFIC EVENTS

CENTENARY OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN[1]

THE Geological Survey of Great Britain is the oldest national geological survey in the world, having now been in active existence for a hundred years It owes its inception to the private enterprise of the late Sir Henry Thomas De la Beche, who became its first director Geological material was quickly accumulated and De la Beche was compelled to ask for museum accommodation This was provided in a house in Craig s Court, Charing Cross, where it was opened to the public in 1841, as the Museum of Economic Geology In 1851, the museum was transferred to Jermyn Street, where it has continued until recently For many years past, however, the space available has been inadequate, and it has been impossible to display to full advantage the very extensive collections of rocks fossils and minerals in the possession of the survey and museum In 1912, the Bell Committee recommended the transfer of the museum and survey to a site in South Kensington next to the Natural History Museum but no action was taken until the Museums Commission met in 1927 The government then agreed to the transfer, and the new building was completed by H M Office of Works in 1933 Occupation by the Geological Survey was, however, delayed by its utilization as the meeting place of the World Economic Conference, 1933

It is now announced that the new Museum of Practical Geology will be formally opened next July Advantage has been taken of this to arrange a joint celebration of the centenary of the Geological Survey and the opening of the new museum In the new museum at South Kensington ample accommodation has been provided to display the exhibits in a building specially designed to meet modern museum requirements New material has been acquired from many sources and the extent and scope of the exhibits has been enlarged For the past three or four years, geologists of the survey and museum have been mainly engaged in rearranging and bringing up to date the collections, their normal field work being subordinated to the needs of the museum At the back of the museum new offices have been provided for the Geological Survey, together with modern laboratories for the prosecution of petrological and mineralogical research Enlarged accommodation has been provided for the library and collection of maps which, as in the past, will be available for consultation by the public The museum is to be opened by the Duke of York on July 3 On July 4 there will be a morning reception of delegates to the centenary, followed by an address by the director of the survey on the history and functions of the Geological Survey of Great Britain On the evening of July 4 there will be an evening reception by H M Government Excursions to several of the classic areas of British geology follow immediately after the meetings It is expected that a large and representative gathering of geologists from all parts of the world will be present for the celebration

[1] From *Nature*

INVESTIGATION OF WEATHER CONDITIONS IN THE STRATOSPHERE

PLANS for continuing the study of weather conditions in the stratosphere by means of sounding balloons equipped with sensitive recording instruments have been announced by the Division of Meteorology of the Massachusetts Institute of Technology The study will begin soon at Lambert Field Airport in St Louis, Mo , where the institute already has carried out two successful investigations of this type

Chris Harmantas, who will be in charge of field operations, has left for St Louis He took with him 36 sounding balloons While the time of their release will depend on weather conditions, it is hoped that they may be sent up within a short time

Each balloon will carry a specially designed instrument, weighing only a few ounces, for automatically recording temperature, humidity and atmospheric pressure The balloons will be only partially inflated in order that they may expand upon reaching the rarefied air of the stratosphere Upon reaching their limit of expansion they will burst, allowing the instruments, which are encased in shock absorbent frames, to fall to the earth Each will carry an identification label offering a reward for its safe return to Professor C -G A Rossby, director of the division

Following the balloon flight last November, 29 of the 35 bags released were found and returned by residents within a radius of 100 miles around St Louis In view of the more favorable season, institute meteorologists hope to recover an even greater number in the forthcoming tests

While the data obtained in the previous investigations are still being studied, several interesting observations have been made concerning the nature of the stratosphere, that layer of the atmosphere where temperature no longer decreases with height. At the base of the stratosphere over St Louis last November, extraordinary fluctuations of temperature, ranging from 36 degrees below zero Fahrenheit to 78 degrees below, were recorded The base of the stratosphere itself was found to vary greatly in height, shifting suddenly from 25,000 to 40,000 feet above the earth.

RESEARCH FELLOWS AT YALE UNIVERSITY

EIGHTY FIVE research projects are being carried on at Yale University this year by a similar number of research fellows who already have the Ph D degree Many of them are recipients of fellowship awards by the Yale Graduate School or by outside organizations others are members of the faculties of colleges and universities to whom the facilities of its faculties, its libraries and laboratories have been made available without charge Eleven foreign countries and eighteen foreign and sixty-two American institutions of higher learning are represented among this group of scholars

Among those carrying on research in the sciences are

Dr Charles D Bock, of South Bend, Indiana, is making a study of the fundamental phenomena involved in the interaction between ions and gases Dr John S Burlew, of New Haven, Conn, is beginning a coordinated series of researches on the nature of the liquid state Dr Tze Tuan Chen, of Foochow, China, is extending his study of the mechanism of heredity among some unicellular organisms

Dr Marion E Howard, of New York City, is conducting research on vitamins Dr Fred E Ingerson, of Barstow, Texas, has undertaken a study of petro fabrics

Dr Orvel H Mowrer, of New Haven, Conn, is studying specific reflexes elicited in certain sense organs in the non acoustic portion of the otic labyrinth Dr Sidney S Newhall, of New Haven, in cooperation with Dr Deane B Judd, of the Colorimetry Section of the Bureau of Standards, is making a scientific study of the nature and course of chromatic adaptation

Dr Ernest C Pollard, of Lincolnshire, England, continues his investigation of the light atomic nuclei Dr William C Randels, of Alma, Michigan, is studying mathematical problems in connection with the Fourier series under the direction of Professor Hille

Dr Helen G Richter, of New Haven, is attempting a completion of data obtained on sympathetic vaso motor pathways and their central connection Dr Julien A Ripley, Jr, of Hamden, Conn, is continuing research on the philosophy of science

Dr Harold H Williams, of Howard, Pa., is extending his research to the possible rôle of cholesterol in fat mobilization Dr Max Zorn, of Hamburg, Germany, is attempting to develop an elementary method in studying higher laws of reciprocity in the field of mathematics

Two Bishop Museum fellows are conducting research in the islands of the Pacific Dr Horace B Baker, of Philadelphia, Pa, is making an anatomical and systematic study of the Pacific Zonitidae at the Bishop Museum under the direction of Dr C Montague Cook, Jr Dr Ernest Beaglehole, of Wellington, New Zealand, is making a general ethnographic study at Puca Puca in the Tuamotu group of islands. In the field of chemistry, Dr Robert O. Bengis, of New Haven, is holder of the Standard Brands, Inc., fellowship, Dr. Werner Bergmann, of New Haven, and Dr Mearl A Kise, of Allentown, Pa, hold Textile Foundation, Inc, fellowships; Dr John A Crowder, of New Haven, and Dr Frank Stodola, of Hopkins, Minnesota, are working under the auspices of the National Tuberculosis Association, Dr Kathleen O P Jackson, of Devon, England, is the holder of a Henry Fund fellowship, and Maurice L Moore, of Crestview, Fla is A Homer Smith fellow

The following hold fellowships from the General Education Board Dr Adrian Buyse, of Rochester, New York, in zoology, Dr Harry G Day, of Chariton, Iowa, in physiology, Dr William W Greulich, of Los Altos, California, in anatomy, Dr Sander E Lachman, of Baltimore, Maryland, in clinical medicine, and Dr John B Wolfe, of Dryden, Virginia, in psychology The National Research Council is represented by the following Dr Harold E Clark, of Montague, Massachusetts, in botany and physiological chemistry Dr Jack M Curtis of St Louis, Missouri, in anatomy, Dr William U Gardner, of Columbia, Missouri in anatomy, and Dr Louis S Goodman, of Portland, Oregon, in pharmacology and toxicology Recipients of Rockefeller Foundation fellowships are Dr George Seth, of Edinburgh, Scotland, in psychology, and Dr Donal Sheehan, of Manchester, England, in physiology Holders of Alexander Brown Coxe Memorial fellowships are Dr Jane L Chidsey, of Easton, Pa in physiology, Dr William G Gordon, of New York City, in physiological chemistry, Dr Arild E Hansen, of Minneapolis, Minnesota, in clinical medicine and pathology, and Dr James M Orten, of Denver, Colorado, in physiological chemistry The Davis and Geck fellows are Dr Irving Friedman of New York City, and Dr Orvan W Hess, of Margaretville, New York, both in surgery

SYMPOSIUM IN THEORETICAL PHYSICS AT THE UNIVERSITY OF MICHIGAN

THE Symposium in Theoretical Physics at the University of Michigan will be held between the dates of June 24 and August 16 Professor Enrico Fermi, of the Royal University of Rome, will lecture throughout the session on "Selected Subjects in Quantum Mechanics" He will place special emphasis upon applications to nuclear physics and other recent developments Professor Felix Bloch, of Stanford University, will present the Quantum Theory of the Metallic State" His lectures will extend from July 1 to July 26 and will treat theoretically the various properties of metals "The Theory of Atomic Spectra" including interpretations of line spectra, the many electron problems, hyperfine structure and nuclear spin, will be offered by Professor S A Goudsmit, University of Michigan He will lecture throughout the session Professor G E Uhlenbeck, of the University of Michigan, will lecture for the first half of the session on "Advanced Quantum Mechanics" The Dirac theory of the electron and positron will receive special attention

In addition to the formal lecture courses, there will be a series of informal seminars throughout the ses-

sion under the personal direction of Professors Fermi, Bloch, Goudsmit and Uhlenbeck, at which recent developments of theoretical physics will be discussed Holders of the doctor's degrees may attend all sessions as guests of the university

In addition to the symposium proper, the department of physics offers a very complete schedule of graduate courses, with special facilities for research in the following fields spectroscopy, throughout the entire spectrum from x rays to the far infrared, chemical analysis by spectroscopic methods, sound, vacuum tube phenomena and high frequency measurements For additional particulars and announcements address the director of the Physical Laboratories, University of Michigan

THE HARVARD SUMMER GRADUATE SCHOOL OF ASTRONOMY

THE summer of 1935 marks the inauguration of the Harvard Summer School of Astronomy which is to meet concurrently with the Harvard Summer School of Arts and Sciences While, in the past, the department of astronomy has offered instruction in elementary astronomy during the summer and has made available facilities for research under the guidance of members of the staff of the observatory, this reorganization of summer instruction provides particularly an extension of the opportunities for advanced instruction, for the pursuit of research, and for profit from informal conferences and colloquia At the same time the program of elementary instruction has been extended

The staff of the department is enlarged during the summer session by a number of visiting astronomers who offer seminars in their special fields, contribute to the informal discussions, and assist in the guidance of those engaged in research

The equipment available to graduate students at the observatory and at the astronomical laboratory includes

1 The collection of some 400,000 photographic plates accumulated by means of the many photographic telescopes at the three stations of the observatory—at Cambridge, at Oak Ridge and at the southern station, formerly at Arequipa, Peru, but, since 1927, at Bloemfontein, South Africa

2 The library containing a complete collection of current journals, publications of observatories and astronomical treatises

3 The telescopic equipment at Cambridge and Oak Ridge, comprising five visual telescopes with apertures ranging from 15 inches to 6 inches, fourteen photographic refractors with apertures ranging from 16 inches to 1¼ inches, the 24 inch reflector and the 61 inch Wyeth reflector equipped for photoelectric and spectrographic work The Oak Ridge Station is located in the town of Harvard, 25 miles west of Cambridge, is easily accessible and possesses dormitory facilities for those engaged in observational work and a cottage for recreational purposes

4 Accessory equipment comprising a Schilt photometer, a Moll microphotometer, a new microdensitometer, measuring machines, star counting machines and telescopic photometers for use in visual variable star photometry

5 A completely equipped machine shop located at the Astronomical Laboratory, available for the use of those engaged in graduate study who desire to experiment in the construction of special apparatus

Members of the visiting staff include

Dr Ira S Bowen, of the California Institute of Technology, known for his solution of the riddle of nebulium and for his other applications of atomic theory to the prediction and verification of unidentified lines in astrophysical sources

Dr Freeman D Miller, of Denison University, engaged in studies of the structure of the Milky Way on the basis of star counts

Dr Peter M Millman, of the University of Toronto, an authority on meteors and meteor spectra

Dr Antonie Pannekoek, of the Astronomical Institute at Amsterdam, known for his studies of the galactic system and in recent years interested in problems dealing with the production of spectral lines in stellar atmospheres

Dr Otto Struve, director of the Yerkes Observatory of the University of Chicago, known for his interest in the spectroscopic problems that the stars present and for his contributions to the study of interstellar matter

Dr Olin C Wilson, of the Mount Wilson Observatory, whose work concerns the interpretation of stellar spectra and related astrophysical problems

PRESIDENT ANGELL AND THE SOCIETY OF EXPERIMENTAL PSYCHOLOGISTS

TRIBUTE was paid to President James R Angell, of Yale University, as a pioneer and leader in the development of the science of psychology at a dinner given in his honor on April 5 in New Haven by a group of leading psychologists Professor Walter R Miles, president of the Society of Experimental Psychologists, in session at Yale, introduced President Angell and called attention to the fact that thirty years ago he became full professor of psychology at the University of Chicago and first head of the department in which many distinguished psychologists have been trained A correspondent writes

"For fifteen years President Angell was intensively engaged in experimentation and his scientific contributions are many He also wrote a text-book on psychology which was the first after that of William James to come into wide-spread use in schools and colleges and to become an important factor in the dissemination of knowledge of psychology. He was for many years editor of *The Psychological Monographs*,

the series of research publications and he was the fifteenth president of the American Psychological Association

"With Professor John Dewey, who was at Chicago at the same time, President Angell was largely responsible for shifting the emphasis from the study of the structure and elements of mental life to the process of adaptation of the individual to the environment President Angell has also long been distinguished as a collaborator and as a lecturer in the field of psychology In his talk at the dinner President Angell reviewed the tremendous development of psychology in recent decades He said that the science of psychology and human relations has never been more important from the point of view of the needs of the world than it now is and he urged concentration on the study of motivation as the present greatest concern of civilization"

The Society of Experimental Psychologists was organized as a national professional society of restricted membership at Yale in 1928 It has a membership of forty of whom half were at the meeting, which was devoted to informal discussions of psychological problems Professor Walter Hunter, of Clark University, a former student of President Angell, was elected president for the coming year The eighth annual meeting next year, will be held at Clark University

SCIENTIFIC NOTES AND NEWS

PROFESSOR FRANK SCHLESINGER, director of the Yale University Observatory will preside over the biennial congress of the International Astronomical Union which will be held at Paris from July 9 to 17

HONORARY doctorates of laws will be conferred in June by the University of Edinburgh on Dr M M Ogilvie Gordon geologist, on Professor J G Kerr Regius professor of zoology at the University of Glasgow, on Professor J Laird Regius professor of moral philosophy at the University of Aberdeen, and on Dr Alfred N Richards, professor of pharmacology at the University of Pennsylvania

SIR JAMES HOPWOOD JEANS has been nominated for election to a newly established chair of astronomy in the Royal Institution, London

DR CLARK WISSLER, curator in chief of the department of anthropology at the American Museum of Natural History, was elected dean of the scientific staff at a meeting of the council held on April 1 Dr H E Anthony, curator of the department of mammalogy, was elected secretary of the council

THE Distinguished Service Gold Medal of the National Foundation of Optometry has been awarded to Dr Theodore A Brombach, lecturer in optometry at the University of California, for his work on color field studies The medal was presented by Dr Karl T Compton, president of the Massachusetts Institute of Technology

IN recognition of "distinctive service for twenty five years" as dean of the School of Pharmacy of Purdue University, Dr C B Jordan was recently presented with an illuminated parchment by members of the faculty of the school and with a gold watch by J K Lilly, Sr, a member of the board of trustees of the university The presentation took place at a banquet given at the close of the fifth annual Druggists' Business Conference Tributes were paid to Dr Jordan in a series of three minute addresses made by Dr Robert P Fischelis, president of the American Pharmaceutical Association, representing the nation, F V McCullough, Indianapolis, secretary of the Indiana Pharmaceutical Association, and E A O Harrow, Bloomington, president of the Indiana Board of Pharmacy, representing the state, and Dr E C Elliott president of the university

THE American Chemical Society announces that the first Eli Lilly and Company award in biological chemistry, carrying $1,000 in cash and a bronze medal, will go to Dr Willard M Allen, of the University of Rochester Dr Allen, who is only thirty years old, receives the prize for the preparation and chemical purification of the sex hormone progestin The presentation will be made at the eighty ninth meeting of the society in New York during the week of April 22, when Dr Allen will read a paper on his research work Professor Edward Bartow, of the State University of Iowa, president elect of the society, was chairman of the committee of award Other members were H T Clarke, Columbia University, L J Henderson, Harvard University, W R Bloor, University of Rochester, H B Vickery, Connecticut Agricultural Experiment Station, P A Shaffer, Washington University, and D D Van Slyke, the Rockefeller Institute

THE D'Arsonval Prize has been awarded by the French Society of Electrotherapy and Radiology to Dr Etienne Hubert Henrard Belgian physician, for a thesis on "Short Hertzian Waves and Their Medical Applications."

A JOINT meeting of the Louisiana Academy of Sciences with the Louisiana Mississippi branch of the National Council of Teachers of Mathematics and of the section of the Mathematical Association of Amer

ica was held on March 29 Officers of the academy elected to serve for two years are *President,* Dr E H Behre, Louisiana State University, *Vice president,* Dr H L Kearney, New Orleans, *Secretary treasurer,* Professor A L Ducournau, Louisiana State Normal College, Natchitoches, *Permanent Secretary,* Professor Alvin Good Louisiana State Normal College, *Editor,* Dr W R Hammond Louisiana State Normal College, *Chairmen of the Divisions* physical sciences, Dr A R Choppin biological sciences, Professor G B Claycomb, social sciences, Dean Charles W Pipkin, geology geography, Professor H J Chatterton, applied sciences, C R McKnight

J F Norman Green was elected president of the Geological Society of London at the recent annual meeting and Professor P G H Boswell, Professor W S Boulton, Professor H L Hawkins and Sir Thomas Holland were elected vice presidents

Recipients of grants from the Committee on Scientific Research of the American Medical Association include Dr Frank R Menne, professor of pathology at the University of Oregon Medical School, for a study of cholesteremia in rabbits, Dr Lloyd H Ziegler and Dr Arthur Knudson, of the Albany Medical College, Albany, N Y, for completion of their work on activity after recovery from rickets, and F A and F L Gibbs toward the completion of a study of the regions in the cat's brain which have an especially low convulsion threshold The work is to be done in the department of physiology of the Harvard Medical School

Dr James Chadwick fellow of Caius College, Cambridge, and assistant director of research in the Cavendish Laboratory, has been appointed to the Lyon Jones chair of physics in the University of Liverpool as from October 1 next, in succession to Professor L R Wilberforce, who retires at the end of the present session

Professor Willard Alfred Knapp has been named assistant dean of the School of Engineering of Purdue University For some years he has been in charge of the department of engineering extension

A Life Science Group, embodying the three departments heretofore designated under the name of the Department of Biological Sciences, was established on April 1 by the University of California at Los Angeles Dr Loye Holmes Miller, heretofore chairman of the department of biological sciences, has been named chairman of the new group The three new departments will include as chairmen bacteriology, Dr Theodore D Beckwith, botany, Dr O L Sponsler, and zoology, Dr B M Allen

J Eric Thompson, assistant curator of Central and South American archeology at the Field Museum, Chicago, has resigned to accept a position on the staff of the Carnegie Institution of Washington, D C

Professor W H Horning, of the department of forestry at the Iowa State College, has been appointed temporary assistant to John P Coffman, chief forester of the National Forest Service During his absence he will be replaced by G B Hortman

Professor E O Lawrence, of the department of physics, of the University of California, has been appointed a member of the consulting board of the Institute of Cancer Research of Columbia University

At a meeting of the council of the University of Sheffield held on March 8, Professor J B Leathes, F R S, was reappointed representative of the university on the General Medical Council for a further term of three years

The following appointments recently made by the British Secretary of State for the Colonies are noted in *Nature* H Atkinson, to be deputy government analyst, Ceylon, J R E Hindson, inspector of plants and produce, to be assistant superintendent of agriculture Gold Coast, A H Malpas, assistant marine biologist, to be director, Colombo Museum, and marine biologist, Ceylon, D B Sabiston, deputy superintending produce inspector, to be superintendent of agriculture, Nigeria

Dr. Edward H Graham assistant curator of botany at the Carnegie Museum, Pittsburgh, Pa, and Mrs Graham will leave about April 15 for their third season of botanical exploration in the Uinta Basin of northeastern Utah They plan to make collections in the Book Cliff Mountains, which form the southern rim of the basin and in the adjoining arid areas

The William Potter Memorial Lecture was delivered by Dr C E A Winslow, professor of public health in the Yale School of Medicine, on March 29 His subject was 'A Physician of Two Centuries Ago Richard Mead and his Contributions to Epidemiology"

General Frederick F Russell gave an Eastman Memorial lecture at the University of Rochester School of Medicine and Dentistry on March 21 on "The Continuing Need for Research in the Field of Public Health." Professor Dallas B Phemister gave on April 5 the last lecture in the series on "The Growth and Repair of Bone"

The seventh lecture of the current series of the Harvey Society will be delivered by Dr Francis G Blake, Sterling professor of medicine at Yale University School of Medicine, on April 18 at the New York Academy of Medicine. His subject will be "Pneumothorax in the Treatment of Pneumonia."

DR. ROBERT A MILLIKAN made a public address at Southwestern College, Winfield, Kansas, on April 8, entitled "In the Coming Century"

DR JEAN PICCARD and Mrs Jeanette Piccard lectured on April 11 before the Lancaster, Pa, Branch of the American Association for the Advancement of Science The lecture was entitled "A Flight to the Stratosphere"

DR. LOUISE PEARCE, fellow of the Rockefeller Institute for Medical Research, addressed the Western Reserve University Chapter of the Society of the Sigma Xi on April 8 on "Epidemiological Aspects of Vaccinia"

DR THORNE M CARPENTER, of the Nutrition Laboratory of the Carnegie Institution of Washington, lectured in Worcester, Mass, on March 12, at a joint meeting of the Worcester Polytechnic Institute Chapter of the Society of the Sigma Xi and the Worcester Chemists Club The subject of his lecture was "Investigations of the Carnegie Nutrition Laboratory on Basal Metabolism"

DR. R G HOSKINS, director of research for the Memorial Foundation for Neuro Endocrine Research at the Harvard Medical School, and Dr J M Looney, director of laboratories for the same foundation, at the Worcester State Hospital, have been engaged in giving a series of lectures entitled "Recent Advances of Endocrinology" to the Somerset County Medical Society of New Jersey under the auspices of the New Jersey State Medical Society and the Rutgers University Extension Service Dr Hoskins spoke on February 15 at Skillman, New Jersey, and on March 1 at Morristown Dr Looney spoke at Marlboro, N J, on February 22, at Trenton on March 8 and March 22, and at Skillman on March 15

THE fifth annual meeting of the Field Conference of Pennsylvania Geologists will have its headquarters at the Academy of Natural Sciences in Philadelphia, May 31 to June 2 Registration and museum tours will take place from 9 A M to 12 M on Friday, May 31, and at 2 P M the first of the trips will leave Philadelphia to observe the physiography of the Piedmont upland and the adjacent Coastal Plain terraces around Philadelphia An alternative trip to localities of mineralogic and petrologic interest to the north of Philadelphia will also be conducted on that afternoon On Saturday, June 1, the conference will leave the academy at 8 A M on a general trip through the crystalline and intrusive rocks of the Piedmont Belt in the Philadelphia area On Sunday, June 2, they will leave at the same time to examine the lower Paleozoic formations and their relations to the pre Cambrian rocks in the area west of Philadelphia This trip will go as far west as Quarryville, which is the type area of the Martic overthrust On Monday, June 3, a post conference optional excursion to the Coastal Plain of New Jersey will be conducted

THE Special Libraries Association will hold its twenty seventh annual convention in Boston from June 11 to 14 with headquarters at Hotel Statler The organization has now a membership of over 1,600 trained librarians who manage the libraries of industrial concerns, research laboratories, banks, business offices, newspapers, museums, law, medical, scientific and other societies, as well as the specialized departments in large public, college and university libraries —in fact, any library devoted to one special field The importance of trained library service to such special groups is now widely recognized and the Special Libraries Association devotes itself actively to the improvement of the methods and quality of such service The program of the coming meeting includes visits to the special libraries of Harvard University, Massachusetts Institute of Technology and other special libraries in the Boston area besides three general sessions and a large number of group and section meetings The science technology group which includes librarians of several science libraries and of science departments of various colleges and universities, with a membership of over 200 will hold three meetings There will also be opportunity for visits to historic shrines in and near Boston

ACCORDING to the London *Times*, Dr T P Schumann, Johannesburg, chief Union meteorologist, will introduce at the Imperial Meteorological Conference in London in August a proposal in favor of the establishment of a meteorological station at Tristan da Cunha With the support of the conference the Union Government probably will sanction the scheme and proceed with the proposal, which includes the provision of a wireless station for the dissemination of meteorological information The estimated cost of establishing such a station would be £5,000 The experiment would be given one year's trial, but it is believed that it would mean such an improvement on the existing sources of meteorological data at the disposal of the Union that permanency would be justified

DISCUSSION

PEARY'S DISCOVERY OF THE NORTH POLE

THE REV J GORDON HAYES has now since 1924 been writing books and pamphlets with the one object of discrediting Admiral Peary, the discoverer of the North Pole In the length of such occupation he has been exceeded by another British writer, one W

Henry Leewin, who writes of his announced forthcoming book, "A Remarkable History of the Author's 25 Years' Effort to Establish the Truth of 'Peary' and the North Pole" So far as we are aware, Hayes printed his first attack upon Peary in the July issue of the Manchester Geographical Society in 1924 This was followed in 1929 by the book, "Robert Edwin Peary, A Record of his Explorations 1886–09," and now by "The Conquest of the North Pole" (Macmillan, 1935, 317 pp, ill)

This latest book, like its predecessors, is a rare combination of misstatement of facts, of innuendoes, impugnment of motive, omission of vitally important facts, and citations by page of Peary's works, which when examined are found to be quite other than they are stated to be—but all treated with scholarly mannerisms and with an appearance of meticulous documentation which will probably deceive those without a background of knowledge of the subject

One s first impulse is to ascribe all this to ignorance, but statements which can not possibly be explained away by carelessness make it necessary to conclude that Mr Hayes s intent has been deliberately to mislead An instance is the statement (p 47) that Peary placed Dr Cook's 'Bradley Land" upon his maps—preposterous and untrue

The subject of the book has been curiously chosen, since its object is to show that the North Pole has not been reached, except perhaps by Dr Cook, and through the air by Byrd in airplane, and by Amundsen in airship (these two explorers together are covered in the book by three pages of text)

The motif of the volume is in Chapter II ("The Sledge Race for the North Pole"), ten pages of text intended to cover Peary s twenty three years of Arctic effort and the faked trip of the notorious Dr Cook, who is treated seriously and enthusiastically by Hayes, who devotes half the chapter to praise of him

The entire geographical world now knows of the complete exposure in 1909–1910 of the Mt McKinley and North Pole frauds of Dr Cook, and his confession of his 'delusion" published in January of 1910, but there are perhaps some not familiar with Cook's later career and particularly with his stupendous oil swindle, which involved tens of millions of dollars For this in 1923 he was tried and convicted in United States District Court and sentenced to imprisonment in a Federal penitentiary for the term of fourteen years and nine months

With this in mind there is humor of a sort in Hayes's approval of Cook's "My Attainment of the Pole" in these words "This book as a whole bears the stamp of reality, his word had never been doubted Bradley Land, the most important discovery claimed by Cook never appears to have been doubted (no one of reputation believes in it, nor does it appear upon any reputable map W H H), and Peary placed it upon his maps" (this is untrue W H H)

Again Hayes states (p 48), "All that Peary submitted to the Royal Geographical Society were copies of some of his alleged observations" This slurring statement is obviously intended to convey the impression that Peary nowhere submitted his original observations to expert examination Hayes's intellectual honesty thus suffers, since he knows that these original observations were submitted both to the committee of the National Geographic Society in Washington and to the distinguished experts, Mitchell and Duval, who reported to the Congressional committee, and it was upon their unqualified approval that Congress awarded Peary a vote of thanks and recommended his elevation in rank from Commander to full Rear Admiral in the United States Navy

The Royal Geographical Society certainly did not expect that Peary's precious *original* records would be sent across the sea, and, apparently quite satisfied with the copies, they awarded Peary a *Special* Gold Medal which in the 105 years of the society's history has been awarded but four times (to Stanley, Nansen, Peary and Shackleton) The president of the society when conferring this unusual award made a remarkable citation

> It is on these grounds (the examination and approval of Peary s observations by experts) that I stand here to night as the representative of the Royal Geographical Society, and, armed with the full authority of its Council, to welcome you, Commander Peary, as the *first and only* (italics not in the original) human being who has ever led a party of his fellow creatures to a pole of the earth

In discussing Peary s marches when returning from the Pole, Hayes says, "he said he did not ride (*op cit* 193–4, 250–1 also 199)" Not one of these citations supplies any warrant for the statement made by Hayes, and we know from published statements by both Bartlett and Henson that Peary rode much of the way, as is in fact the custom generally when exceptionally long marches are made by dog sled The long daily marches of Peary on his return from the Pole, which have been attacked by hostile critics, had before been many times exceeded on sea ice not only by Peary but by other explorers, as is known to all who have taken the trouble to examine the facts

Since Hayes's treatment of the conquest of the Pole is limited to some fifteen pages in all, the remaining 300 pages of the book are given over to a summary

of Arctic and, almost entirely, British expeditions, none of which had anything whatever to do with attempts upon the Pole The number of books of this character is legion, most of them written, like this one, by persons without experience in the polar regions Some of them are certainly superior to that by Hayes, though some may possibly be worse The strong British and anti American bias of the author, combined with his apparent lack of intellectual honesty or of a sense of values, makes him peculiarly unfitted for a task which calls loudly for sanity of judgment and for some measure of an international view point

William Herbert Hobbs

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Pasadena, California

A STUDY OF THE RELATION OF THE RELATIVE SIZE OF THE TWO HANDS TO SPEECH

From a preliminary study of college students conducted last year at the State University of Iowa evidence was obtained which points to the conclusion that there occurs a difference in the volumetric size of the two hands The hands of thirty four normal speakers, twenty four of whom were right handed, were measured and it was found that 87 5 per cent had larger right hands, while only 8 per cent had larger left hands Eight left handed subjects were studied, five of whom were found to have larger left hands, with only one having a larger right

Since there is assumed to be a lack of dominant lead in the stuttering person, if we further assume that the difference in the size of the two hands is due to development through use it might be expected that findings on normal speakers and stutterers would not agree A similar study was therefore made of thirty three stutterers who had shifted handedness not to exceed a year previous to measurement, but findings were similar to those for normal speakers This group included twenty seven cases who had used the right hand up to time of shift, 85 2 per cent of these subjects had larger right hands, while only 7 4 per cent had larger left hands

By slightly altering the present technique and measuring a large number of cases it will be possible to determine with greater precision the quantity of difference for each person and then compare averages for each group Further, it is the author's purpose to determine the cause of this condition and whether it is pre- or post-natal If it is found to be the latter, attempt will be made—by studying children of various ages—to determine at what age these size differences occur

Clarence R Van Dusen

University of Michigan

EDEMA AND GENERAL ATROPHY IN STENOSTOMUM OESOPHAGIUM

Distended, abnormally large individuals have been found in certain cultures of *Stenostomum oesophagium* An examination of these abnormal animals has led to an investigation of this condition, which has been termed edema A study of the causes of edema in *Stenostomum oesophagium* is now being made

The first step in this edema is the destruction of the main stem of the protonephridium Morphological changes which follow the destruction of the main stem are the accumulation of fluid in the pseudocoel, the distention of the epidermis, the branching of the enteron, the migration of cells from both the epidermis and the enteron, the destruction of many of the elements of the parenchyma, the foreshortening of the capillary portion of the protonephridium and the addition to the number of the flame cells

Certain factors, such as parasitism, light, temperature and hydrogen ion concentration, appear to have little or no effect in producing the atrophy of the main stem of the protonephridium, the quantity of the food ingested seems to be the most important of the factors studied to date Of 325 individuals of a clone, the members of which were fed abundantly 284 died of edema, of 675 individuals of a clone, the members of which were fed only once a day, 46 died of edema A study is being made of other factors that may determine the atrophy of the main stem of the protonephridium and the consequent edematous condition

Margaret Hess

Miller School of Biology
University of Virginia

BANG'S ABORTION DISEASE OF CATTLE

The author, working at the Kansas Agricultural Experiment Station, has developed a strain of *Brucella abortus var bovis* which does not produce agglutinins following massive doses, although a thermal response is noted in each instance Bang negative cattle remain non reactors indefinitely to the standard agglutination tests (rapid and tube), following injection of this vaccine

A live germ vaccine of this strain is readily absorbed without abscessation in all the experimental animals No enlargement of the spleen is noted in guinea pigs and rabbits

Experiments are being planned to determine the protective and immunizing value of this product in cattle under simulated field conditions

Chas H Kitselman

SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS FOR DUSTING SULFUR ON PLANTS IN CONTROLLED AMOUNTS

WHILE making comparative studies on different brands of sulfur, it became necessary to secure dusting apparatus that would deliver quantitatively small amounts of sulfur to the under surface of leaves. Since many brands of sulfur stick tenaciously to dusting equipment and at the same time produce little or no fog, the common methods of applying dust under laboratory conditions were not satisfactory. The apparatus herein described has been satisfactory for the purpose intended and may be of value to other workers.

A dust gun was made from a small glass cylinder 80 mm by 15 mm (A) fitted with two corks. Into one cork was inserted a metal tube with a 1 mm opening which admitted compressed air. The air was under 20 pounds pressure and controlled by a valve (B) obtained from a cheap spray gun. From the other cork led a glass tube fire polished to a 1 mm opening. This glass tube connected by means of a rubber tube (C) with the dusting chamber. The dusting chamber consisted of a large wooden box enclosing a phonograph turn table (D) which was used to transmit power to a cookie can (E) held at a 45° angle with the open end down. Plants grown in flower pots were inserted into the cookie can and revolved as the phonograph turned. The sulfur came into the dusting chamber, hit a glass plate (F) and diffused evenly over the revolving plant. When filling the glass dust gun, a small rod was held in the center of the gun and was removed later. This left a small cylinder of dust, which was gradually removed in its entirety by the force of air passing through the center of the sulfur cylinder on its way to the dusting chamber.

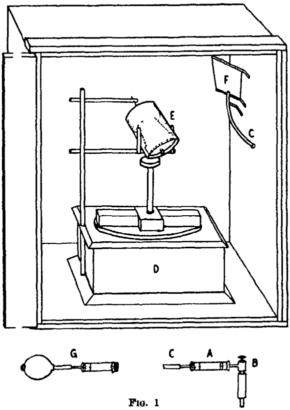

FIG. 1

The dust gun may be adapted into a very useful small hand duster (G) by attaching a rubber bulb to the glass tube and by placing a cheese cloth over the other end. A rod is held in the center of the glass cylinder while filling in the same manner as described above. The cheese-cloth serves as a screen to prevent coarse particles from leaving the duster and at the same time diffuses any large puffs of dust that might be emitted.

MYRON V. ANTHONY

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

A NEW STAINING METHOD FOR STRUCTURES OF THE SPINAL CORD

DISADVANTAGES in staining of cytons and Nissl bodies (chromophilic bodies) of the spinal cord may be overcome by employing dyes that contain greater amounts of methylene violet. Polychromed methylene blue does not contain sufficient methylene violet to prevent fading, especially in combination with acidic contrast dyes, such as eosin. The Nissl methylene blue stain is polychromed with castile soap and allowed to age for some time before use, but fading occurs in a short time if an acidic counterstain is used. Cytons become destained within one week.

By employing the Giemsa stain and differentiating in 95 per cent. and absolute alcohol, a brilliant effect was obtained. However, fading within a few days was noticed when an acidic counterstain was employed.

In order to obtain the advantages of selectivity and permanence the following mixture of dyes and timing was arrived at:

Five parts of a solution of Wright's blood stain in 95 per cent. denatured ethyl alcohol to one part of a standard solution of Giemsa was prepared. The spinal cord of a steer, fixed in 10 per cent. acid-free formaldehyde, was sectioned at 10 mu. Slides were passed through xylol and graded alcohols to distilled water and flooded with the above mixture of dyes for two minutes. The dye was then diluted with an equal amount of distilled water for two minutes and the slides then immersed in fresh distilled water for one minute. The sections were passed immediately into 80 per cent. alcohol for 15 seconds and the dehydration rapidly completed in 95 per cent. and absolute. Sections were cleared in neutral xylol and mounted in neutral balsam.

Dehydration must be rapid so that cyton areas do not become completely destained After washing in 80 per cent alcohol the sections will become reddish in color with blue cyton areas If the dehydration is properly carried out, the following structures will be selectively and permanently stained

Cytons and Nissl granules deep blue, nuclei of blood vessel structures and neuroglia light blue, elastic fibers of blood vessels deep blue, erythrocytes pink, and neuroglia fibers light red

The intensity of the cyton stain may be increased or decreased by varying the proportion of the Giemsa solution in the mixture

L Hansburg

Laboratories of the Standard Scientific Supply Corporation
New York

A RAPID METHOD FOR REMOVING COVER GLASSES OF MICROSCOPE SLIDES

It is often necessary in cytological work to remove the cover glass of a slide, in order to replace a broken cover glass or restain the sections underneath For this purpose most workers use xylene The writer, however, has found that a mixture of 90 parts of xylene and 10 parts of n butyl alcohol acts much more rapidly The hard and brittle balsam or damar of old slides, which would require an immersion of several days in pure xylene, is usually dissolved by this mixture in a few hours This time difference is probably due to the presence—especially in old slides—of a small amount of moisture in the mounting medium around the margin of the cover glass Such moisture would offer a barrier to the penetration of pure xylene, but not to xylene containing n butyl alcohol, for the latter is miscible with small amounts of water, as well as with xylene, balsam and damar It should be remembered that butyl alcohol is a solvent of the aniline dyes, and so material stained with these substances will be destained in this xylene butyl alcohol mixture

J Gordon Carlson

Bryn Mawr College

SPECIAL ARTICLES

X-RAY DIFFRACTIONS FROM HEMOGLOBIN AND OTHER CRYSTALLINE PROTEINS

Several attempts have been made during the past years to get x ray diffraction photographs of the crystalline proteins Most of these[1] have not been successful, but in a few instances very simple patterns have been observed[2] These patterns, which always consisted of two rather broad and diffuse rings, have been found from proteins as different as edestin, excelsin, egg albumin and hemoglobin

The diffuseness of the rings, combined with their simplicity irrespective of diffracting substance, suggests the pattern of a glass or other amorphous material rather than of a crystal The probability that they are such amorphous patterns is strengthened by the recent statement[3] that a typical sharp line pattern can be prepared from a single crystal of pepsin left in its mother liquor

We have been seeking to obtain truly crystalline powder patterns from edestin, excelsin and hemoglobin Photographs prepared in the usual way from (1) commercial edestin, (2) well crystallized edestin and excelsin freshly made from hemp seeds and Brazil nuts and (3) crystalline (white rat) oxy and carbon monoxy hemoglobin gave the familiar "amorphous bands When these preparations were examined microscopically they proved to be more or less completely altered after photography Further microscopic study demonstrated that the protein crystals always decomposed rapidly on exposure to air From the way this disintegration took place it was clear that they all contained water of crystallization which was very readily lost

Photographs with copper K radiation were accordingly made of the wet crystals sealed into thin containers having windows of 0 01 mm glass Under such conditions the protein crystals remain unchanged and typically crystalline patterns, consisting of fine, though very faint lines are produced With this experimental arrangement reflections corresponding to large spacings lie too close to the central image for accurate measurement Additional, and far more instructive, photographs have consequently been made with the longer chromium K radiation by keeping samples in moist chambers without protective windows Some spacings thus measured on typical pictures of rat oxyhemoglobin are listed in Table I There is no reason to believe that we have yet established the largest spacings that exist for this hemoglobin or for the other protein crystals Our techniques, however, are being improved and it is expected that these maximum spacings will eventually be determined

[1] For example, R O Herzog and W Jancke, *Naturwiss*, 9: 320, 1921, W H George, *Proc Leeds Phil Soc*, 1 412, 1929

[2] See J R. Katz, "Die Röntgenspektrographie als Untersuchungsmethode" (Berlin, 1934), p 188

[3] J D Bernal and D Crowfoot, *Nature*, 133 794, 1934

TABLE I

SPACINGS OF SOME POWDER LINES OF OXYHEMOGLOBIN

Spacing	Estimated intensity	Spacing	Estimated intensity
45 7 A	s (broad)	10 4 A	m
27 5	m	9 4	f
21 7	m –	8 4	f
18 0	ff	5 93	ff
15 4	f	4 90	ff
13 0	m	4 62	f
11 6	ff	3 47	ff

In this table s, m, f, ff represent strong, medium, faint and very faint It is possible that one or two of the fainter lines are beta reflections

In the meantime it may be concluded that

(1) The proteins edestin, excelsin and hemoglobin crystallize with water of crystallization, which is very readily lost The band pattern previously described as common to these and other proteins is produced by apparently amorphous materials resulting from the efflorescence of the crystalline compounds

(2) If care is taken to prevent the decomposition of their crystals, these proteins give typical powder patterns rich in sharp lines Some of the observed spacings are much longer than those found from insoluble protein structures like silk, hair and tendon

RALPH W G WYCKOFF
ROBERT B COREY
ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH
NEW YORK

EFFECTS OF THEELIN ON THE MALE GENITAL TRACT

THE principal known action of theelin (ketohydroxyoestrin) is to induce tissue proliferation in the accessory genital organs of the female This has been demonstrated in the usual laboratory animals, the monkey and man Since an oestrus inducing agent has been extracted from the urine of normal human males[1] it seemed desirable to study the action of theelin on the male genital tract Some changes have been described in the mouse[2] and rat[3], and in the male monkey it is known that this oestrogenic extract is responsible for a sexual skin reaction

The effects of interest here have been brought about by the subcutaneous injection of 60 cc of theelin[4] over a period of thirty four days into an immature male monkey weighing 2,450 gms at autopsy A cage mate of similar age, weighing 3,000 gms at autopsy, was used as a control The most striking change in growth was found in the seminal vesicles, those of the injected animal weighing 5½ times as much as those of the control Histological study showed the increase entirely due to muscular hypertrophy of the walls of the vesicles There had been no stimulation of the secretory epithelium, and the lumen of the individual tubule had fewer outpocketings than the control It appears that the activity within the wall had restricted concurrent increase in lining epithelium. The ejaculatory ducts were enlarged Within the prostate there was also a relative increase in fibromuscular stroma at the expense of the epithelial glands. As in the prostate of the adult castrate monkey, where the epithelium is markedly degenerated, the prostate takes a more posterior position in relation to the urethra Another striking tissue change was found in the prostatic utricle where extensive cornification of the epithelium had taken place increasing the thickness of the epithelium as much as twenty five times

The prostatic utricle is a remnant of the Mullerian ducts and as such the change here is analogous to the well known effect in the vaginal mucosa In view of this the report of a similar effect[2] in the posterior prostatic lobes of the mouse may indicate that these lobes are not true prostate but have an origin in common with the utricle In the monkey this cornification extended along the posterior wall of the urethra into the membranous portion and the columnar epithelium of the pars cavernosa had become cornified

Notwithstanding the great development of the scrotal sac the right and left testes (which had not increased in size) lay in the groin 3 5 cm and 2 5 cm, respectively, from the external inguinal rings There was incontinence of urine and the usual swelling of superficial tissues about the distal portions of the genital tract

G VAN WAGENEN
YALE UNIVERSITY SCHOOL OF MEDICINE

1 E Laqueur, E Dingemanse, P C Hart and S E de Jongh, VI Mitteilung Klin Wchnschr, 6 1859–1868, 1927

2 Harold Burrows and N M Kennaway, *Am Jour Cancer*, 20 48–57, 1934

3 John Freud, *Biochem Jour*, 27 1438–1450, 1933

4 Through the courtesy of Dr Oliver Kamm, of Parke, Davis and Company, we have received theelin for this study

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SCIENCE

VOL. 81 FRIDAY, APRIL 19, 1935 No 2103

SCIENCE A Weekly Journal devoted to the Advancement of Science edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster, Pa Garrison, N Y

Annual Subscription $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

REVIEW OF SOME OF THE MORE RECENT ADVANCES IN THE STUDY OF BLOOD DISEASES[1]

By Professor CYRUS C STURGIS M D

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PROGRESS in hematology, as in any other science, depends to a great extent upon new and accurate methods of observation As has been emphasized by Sir Humphry Rolleston,[2] probably the two most important steps which led to a great increase in our knowledge of blood diseases were the introduction of the microscope, and especially the compound, achromatic form by G D Amici a hundred years ago, and the development of the modern methods of staining blood by Paul Ehrlich, which he began in 1877

The entire field of medicine from a scientific stand point has progressed more rapidly during the past 50 years than it has at any other time in the history of the world New, valuable and accurate information which has an important bearing on the cause and cure of disease has accumulated so rapidly that those who teach the practice of medicine and are interested in problems of medical research find that it requires a great effort on their part to keep abreast with the advances which are being made, even when their interests are largely restricted to a specialized field

The science of hematology illustrates as well as any other branch of medicine that these statements are true, for during the past decade many new and fundamental facts have been discovered which have an important bearing upon the etiology and the treatment of certain blood diseases

As it will be necessary obviously to limit this discussion, it is essential that my remarks be confined to

[1] Address of the vice-president and chairman of the Section of the Medical Sciences, delivered before the General Session, American Association for the Advancement of Science, Pittsburgh, December 27, 1934

[2] Sir Humphry Rolleston, *Proc of the Royal Soc of Med.*, 27 31-48, July, 1934

a few outstanding achievements in this field which have been developed recently on a sound scientific basis. I propose to discuss only three phases of hematology in which recent and important contributions have been made to our knowledge. They are (1) The etiology and treatment of pernicious anemia, (2) the iron deficiency anemias and their treatment, and (3) the etiology of agranulocytosis.

Pernicious anemia is a disease which was first described by Thomas Addison in 1849, 85 years ago. Until 1926, the following would have been a correct and concise definition of the condition: 'It is a disease of unknown causation, most frequently occurring at middle life or later, usually characterized by a marked reduction in the red blood cells and hemoglobin of the peripheral blood, always associated with an absence of hydrochloric acid in the gastric secretions, and frequently complicated by degenerative changes in the nervous system.' It was also necessary to add to this definition that the disease progressed, usually with spontaneous remissions, to a fatal termination within 2 or 3 years from the earliest appearance of symptoms. Before that time many types of treatment had been advocated, but with the possible exception of blood transfusions which had only a very transient beneficial effect, it could not be proven that any form of therapy prolonged the life of a given patient a single day.

Interest in the modern treatment of pernicious anemia dates from the experimental work of George H. Whipple, who in 1925[3] demonstrated that the blood of dogs, made anemic by repeated hemorrhages, would return to normal more rapidly if liver was added to the diet. It is undoubtedly true that other investigators had previously used liver in the treatment of various types of anemia, but it was the work of Whipple and later of Minot and Murphy[4] which brought this form of therapy to the attention of the general medical profession. The latter observers proved conclusively that the feeding of 240 grams of calf's liver daily would invariably induce a remission in a patient with pernicious anemia, which usually began within 3 to 6 days after the treatment was instituted. The resultant increase in red blood cells was usually at the rate of 400,000 to 500,000 cells per cu. mm. per week until the normal level of 4.5 to 5 million per cu. mm. was reached. Simultaneously with this improvement in the blood condition, there was a remarkable disappearance of all the patient's symptoms, and, unless some complication existed, there was a complete return to a state of normal health. Moreover, it has been demonstrated that this condition can be maintained apparently for an indefinite period of time, provided an adequate amount of liver is consumed. Subsequent developments in liver therapy have been the production of a concentrated soluble liver extract for oral use by Minot and Cohn[5] and similar potent products for intramuscular use by Gansslen[6] and intravenous use by Castle and Taylor.[7] These facts which have just been related demonstrate that the liver contains an unidentified substance which will cause the blood of a patient with pernicious anemia to return to normal if it is administered in appropriate amounts. Additional investigation has shown that the anemia of pernicious anemia exists primarily because there is a delay in the development of the red blood cells in the bone marrow.[8] As a result they can not be released to the peripheral blood in sufficient numbers to maintain the red blood cell count at a normal level. The failure of the red blood cells to develop normally has been termed a "maturation arrest." It can be stated definitely, therefore, that this form of anemia is due to defective blood formation.

Within recent years Castle and his associates[9] have completed and published a brilliant series of investigations dealing with the relation of the stomach to the cause of pernicious anemia, which has given more information concerning the etiology of this condition than any other contribution. For many years it was thought that a defect of the stomach had some causal relationship to pernicious anemia, but the exact nature of this association was unknown until Castle reported his recent studies. That some disorder of the stomach played a rôle in the etiology of pernicious anemia was suggested by the almost constant presence of gastric symptoms in patients with the disease, the uniform lack of hydrochloric acid in their gastric secretions and the rare but definite observation that complete removal of the stomach in human beings was followed by changes in the blood which were identical with those of pernicious anemia. In brief, it was demonstrated by Castle that when gastric juice which is obtained from normal human beings is incubated with uncooked Hamburg steak, a substance is elaborated which has the same action and is as effective as liver in controlling pernicious anemia. These experiments, which have been adequately controlled and confirmed, indicate clearly that there is some unidentified substance (the intrinsic factor of Castle) in nor-

[3] G. H. Whipple and F. S. Robscheit-Robbins, *Am. Jour. Physiology*, 72: 408, May, 1925.

[4] G. R. Minot and W. P. Murphy, *Jour. Am. Med. Assoc.*, 87: 470, Aug., 1926.

[5] E. J. Cohn, G. R. Minot, J. J. Fulton, H. F. Ulrichs, Florence C. Sargent, J. H. Weare and W. P. Murphy, *Jour. Biol. Chem.*, 74: 69, July, 1927.

[6] M. Gansslen, *Klin. Wchnschr.*, 9: 2099, 1930.

[7] W. B. Castle and F. H. L. Taylor, *Jour. Am. Med. Assoc.* 96: 1198, 1931.

[8] I. Zadek, *Ztschr. f. Klin. Med.*, 95: 66, 1922.

[9] Wm. B. Castle, W. C. Townsend and C. W. Heath, *Am. Jour. Med. Sci.*, 180: 305, Sept., 1930.

mal gastric secretions which is closely related to the normal mechanism of red blood cell formation Furthermore, this substance must react with some article of diet (the extrinsic factor which is likewise unidentified) to form a heat stable material which is stored in the liver, and released as needed to regulate the rate of maturation of red blood cells in the bone marrow These known facts compel us to conclude that the immediate cause of pernicious anemia is a lack of the intrinsic factor in the gastric secretion, but the factor which is responsible for this still remains obscure Recent work at the Simpson Memorial Institute[10] indicates that the intrinsic substance is not entirely absent in the gastric juice of all patients with pernicious anemia, but is present in inadequate amounts This can be demonstrated by collecting considerable quantities of gastric juice from patients with pernicious anemia and after incubating large quantities of it with Hamburg steak, inducing a remission by administering it to patients with the disease

Pernicious anemia has been called a 'macrocytic anemia" because a majority of the red blood cells of the peripheral blood are larger than normal There are several conditions, however, which will produce a similar type of anemia This is apparent when the normal mechanism which regulates the rate of red blood cell production is considered The substance which controls this is the end result of a series of at least four essential steps If any one of these is lacking, the red blood cells will not maturate properly, and a macrocytic anemia will result The first essential to the normal development of blood is the ingestion of an adequate amount of material in the diet which has been called the extrinsic factor ' When this is lacking, as it probably is in certain tropical anemias a macrocytic type of anemia results Second, this variety of anemia will result when there is an absence of the intrinsic factor in the gastric secretions As previously stated, this is known to occur in true Addisonian pernicious anemia Third, although the extrinsic and intrinsic factors may be present and interact properly, the elaborated product may not be absorbed normally and the characteristic anemia will appear This has been known to occur, for example, in a small group of patients who have had multiple intestinal anastomoses for some surgical reason As a result there may be only a small portion of the intestines available to absorb this blood regulating substance and, therefore, the amount which is made available to the body may be inadequate Finally, a macrocytic anemia may result, following wide spread liver damage which seriously impairs the storage capacity of this organ While the material which regulates the maturation of the red blood cells is made in the stomach, it is stored in the liver, where it is released as required to regulate the orderly rate of red blood cell production As a result of certain diseases, such as cirrhosis of the liver, this latter function may fail and a macrocytic anemia appear

The work of Castle suggested to Sturgis and Isaacs that possibly gastric tissue itself should be potent in the treatment of pernicious anemia In 1929[11] they demonstrated that desiccated, defatted hog stomach (Ventriculin) had a similar action to liver and that it was an effective form of therapy in this disease

This group of experiments which have just been discussed have therefore, furnished effective methods of controlling a disease which was hitherto invariably fatal, and also have provided additional information of prime importance which may eventually lead to a complete cure by the elimination of the fundamental cause of the condition

I now wish to turn to an entirely different type of anemia but also a condition about which our knowledge has increased greatly during the past few years I refer to the iron deficiency anemias which have in common a depletion of the iron reserves of the body due to various causes

While no attempt will be made to discuss the metabolism of iron in the body, the following facts should be emphasized The entire iron content of the body of an average human adult is estimated to average about 3 grams Eighty per cent of this is found in the blood serum and in combination with hemoglobin, which contains 0 335 per cent The average iron intake of an adult in the United States is commonly accepted as about 15 mg daily and of this amount about one half is eliminated in the feces Only the slightest trace, if any, is excreted through the kidneys The body possesses a remarkable mechanism for the conservation of iron, as it is used over and over again In addition, if the iron intake is reduced sufficiently, the amount eliminated in the stools is decreased and may entirely disappear

As iron is an essential part of the hemoglobin molecule, it is perfectly clear that this essential material can not be synthesized in the absence of the metal, and an anemia will develop Let us then consider the conditions which may result in the depletion of the iron stores in the body and a resultant anemia

An iron deficiency of the body may result when there is an insufficient intake of this metal in the diet An anemia of this type rarely occurs in adult males, but it is common in infants, women and in growing children It has been clearly established that adult males will not develop an anemia when the iron intake is as small as 6 mg daily In women such fac

[10] Raphael Isaacs and S Milton Goldhamer, *Proc of the Soc for Exp Biol and Med*, 31 706, 1934

[11] Cyrus C Sturgis and Raphael Isaacs, *Jour Am Med Assoc* 93 747, Sept, 1929

tors as menstruation, pregnancy and lactation cause increased demands for iron and the reserves of this metal will be reduced and an anemia appear, if there is a deficiency of dietary iron This is also true of children during a period of rapid growth, especially if there is an associated infection

Another cause for a deficiency of iron in the body is seen in women between the ages of 20 and 40 years who apparently are unable to absorb iron in adequate amounts, despite the fact that a sufficient quantity is present in the diet Such a condition gives rise to changes in the blood which are designated as idiopathic hypochromic anemia of women, characterized by a red blood cell count which is not strikingly changed but a hemoglobin percentage which may be 50 per cent of normal or less While the entire mechanism concerning the absorption of iron is not known, it has definitely been established that hydrochloric acid in the gastric contents favors the absorption of this element, whereas the absence or diminution of this acid impairs it That the absence of it may play a rôle in the production of this type of anemia is indicated by the fact that all patients with this disease have an achlorhydria

Probably the most common type of iron deficiency anemia is observed when there is an excessive loss of this metal from the body, such as occurs in any condition causing chronic hemorrhage Even a small daily loss of blood, if continued constantly for months, will gradually but severely deplete the iron reserves of the body If the cause of the hemorrhage is controlled and the patient is partaking of a diet which is not poor in iron there will be a gradual regeneration of red blood cells and hemoglobin until the normal is reached Such a condition is a definite therapeutic indication for the administration of iron, as it will greatly facilitate the return of blood to normal In the anemia which results from uncomplicated acute hemorrhage, however, iron does not have a therapeutic effect, as the normal reserve stores of this substance in the body are usually adequate to accomplish a regeneration of hemoglobin at the maximum rate

In past years there has been a great deal of discussion concerning the therapeutic value of various forms of iron At present it appears to be definitely established that the effectiveness of any given form of iron is directly proportionate to its metallic content I prefer to use, therefore, reduced iron which contains 90 per cent of the element Ferric ammonium citrate, which contains approximately 16 per cent of metallic iron, is also satisfactory In order to produce satisfactory results, however, the dosage of the preparations must be much larger than is ordinarily advised For reduced iron the maximum therapeutic dosage is 0.5 grams three times daily and for ferric ammonium citrate it is 2 gm three times daily When large doses of iron are administered, a very large percentage of it is excreted in the stools, and the reason why such a large dose is required to produce a therapeutic effect is not known

The third blood disease for discussion is a condition which has been recognized only in recent years In 1922 Warner Schultz[12] described what he regarded to be a new clinical entity, characterized by ulcerative lesions of the mucous membranes of the mouth and throat, a marked reduction or complete disappearance of the polymorphonuclear neutrophil cells of the peripheral blood, marked prostration and a rapidly fatal termination He called this condition agranulocytosis, but later the name agranulocytic angina was given it and more recently other names such as granulopenia, granulocytopenia, malignant neutropenia and others have been applied to it Historically at least, the terms agranulocytosis and agranulocytic angina have the preference and for that reason will be used in this article

The mechanism of the production of this disease appears to be as follows Some unknown agent causes the polymorphonuclear neutrophil cells of the peripheral blood to diminish in number or disappear completely either by depressing the action of the bone marrow where they are formed or by causing an increased destruction of them in the blood stream or possibly by a combination of these two factors As a result, one of the major defense mechanisms against infection is impaired This permits the pathogenic organisms which are always present on the mucous membrane surfaces of the body to invade the tissues, producing ulcerative lesions and, in some instances, to develop in the blood stream which almost always results in a fatal termination While some patients may not have severe symptoms in association with this disease, it must always be regarded as a serious condition because the mortality in the untreated cases is almost 75 per cent When it is recognized in its early stages and pentnucleotide therapy and blood transfusions are given, and these are the most promising forms of treatment, the mortality has been reduced to about 25 per cent

For over a decade after Schultz had directed the attention of the medical profession to this disease, the cause of the reduction or disappearance of the polymorphonuclear neutrophil cells from the blood was undetermined nor was it possible to account for the characteristic tendency of these patients to suffer from relapses

In October, 1933, Madison and Squier,[13] however,

[12] W Schultz, *Deutsche med Wchnschr*, 48: 1495, 1922

[13] F W Madison and T L. Squier, "Primary Granulocytopenia after Administration of Drugs Containing a

reported before the Central Society of Clinical Investigation that the syndrome of agranulocytosis might be precipitated by the use of drugs composed of a combination of a barbiturate with amidopyrine This type of medication is often prescribed by physicians and is used more and more by the non medical public on their own initiative These investigators observed that 14 of their patients with the disease had taken amidopyrine alone or in combination with other drugs, such as a barbiturate, immediately before the onset of the disease This report immediately aroused my interest in this possible etiological relationship and as a result a study was made of our cases of the disease at the University of Michigan [14] Ten patients have been observed in this hospital and it was definitely established that all of them had taken drugs or combinations of drugs containing amidopyrine in a short time before the earliest symptoms appeared Although these observations and those contained in a number of other subsequent reports indicate clearly that patients with this disease frequently take amidopyrine before the onset of the condition, it is only indirect evidence that there is a causal relationship between this drug and agranulocytosis More convincing data have been obtained by administering small doses of amidopyrine orally to patients who had recovered from the disease and determining the white blood cell count every half hour for four hours In each one there was a striking decrease in the number of polymorphonuclear neutrophil cells of the peripheral blood which reached a maximum in 1½ hours and then returned to normal at the end of 4 hours A repetition of the test in two of the patients produced exactly the same effect These tests were controlled by observing the white blood cell count every half hour in these same patients, during which time no drug was given Furthermore, the administration of this drug to two normal persons did not produce significant changes in the leucocyte count during a four hour interval

It is my opinion that amidopyrine is the drug which precipitates the disease in certain persons who are susceptible to it As it is a widely used therapeutic agent and agranulocytosis does not have a high incidence, it must be concluded that the percentage of persons who are sensitive to it is not great

WHAT IS A PROOF?[1]

By Professor EDWIN B WILSON
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Our first notion of proof may have been different from person to person, but I dare say that for none of us was it the logical process and the Q E D of geometry, for all of us it was probably something quite authoritarian which first brought conviction—a reiterated statement, a punishment, an emphasis, possibly just the stamp of a foot, maybe an example, a bit of cajolerie, a reward or merely an acquired habit This type of proof is not to be ignored, it is widely and effectively used to demonstrate the excellence of a cigaret, the indispensability of a governmental measure or the soundness of a social theory Thus, if we were to give to the term proof a definition which had any wide validity in human affairs we should have to use some such phraseology as "a process by which A induces in B a sense of the justification for a conviction"

We may remark that A and B may be the same individual We should note that the proof is relative to B in whom the sense of justification for the conviction is induced by the process When a class in plane geometry first meets the Pythagorean Theorem (Euclid I, 47) with its complicated auxiliary construction lines and lengthy reasoning, the proof given will not be such to most of the youngsters because it does not carry to them a sense of justification, it is blind Or, again, when a class in differential calculus reaches the subject of maxima and minima, the teacher with a few necromantic passes, verbal and graphical, may prove in a manner which carries both a conviction and the sense of its justification, the rule that to find maxima or minima of a function the derivate is set equal to zero, yet he knows that the theorem as stated is neither proved nor true What may be a perfectly good proof to B may be none to A, who gives it, and a perfectly good proof to A may be none to B, who receives it

That which has been illustrated relative to proofs of familiar propositions, holds equally of facts, as may be seen by reading "Fact The Romance of the Mind," the latest book of Henry Osborn Taylor, our very illustrious historian of thought, wherein you can learn that what at some time has been considered indubitable fact might not be so considered now—

Benzene Chain,'' presented at annual meeting of Central Society for Clinical Research, Chicago, Oct. 27, 1933

[14] Cyrus C Sturgis and Raphael Isaacs, ''Observations concerning the Etiology of Agranulocytosis'' (*Trans of the Assoc of Amer Physicians*, 49 328, 1934)

[1] Read at the Pittsburgh meeting of the American Association for the Advancement of Science, before a joint session of Sections K and A with the American Mathematical Society and the Mathematical Association of America and the Econometric Society

and who among the ancients if he should be now among us could consider as fact some of the things we here cherish as such?

I have alluded to mathematical proofs We learned the paraphernalia thereof in geometry consisting of definitions, postulates or axioms and demonstrations The whole was a logical construct based on conceptions and without any other kind of reality However much you might stumble mentally at the Pons Asinorum, you could not stub your toe on it! So far as many of us believe, we sense only material things, things containing mass or energy A point being position without extension could therefore not be directly sensed Indeed, if we adopt the principle of indeterminacy, as some of us do, how could we specify the position of a point without endowing it with an infinite momentum? And in view of our notions on relativity should we not have to speak not at all about points in space but of events and of space-time?

You thus all see what a terribly unreal fiction this plane geometry is Fortunately, this does not bother the high school teacher or the modern physicist could never have got his necessary mathematical start

In the above extravaganza, or excursion into reality, I am merely trying to emphasize the idealization which is necessary to get up a system of plane geometry and the purely conceptual nature of geometry Our definitions, postulates and theorems apply to things which do not exist materially Now when the trusting schoolboy, who does not appreciate what is being imposed on him, having learned that the area of a triangle is half its base times its altitude undertakes to apply this theorem to find the area of a somewhat triangular object, as may be needed for some practical purpose, he quite unconsciously makes more postulates or assumptions, to wit, that the given object is sufficiently triangular so that he may apply his theoretical formula to the solution of a practical problem In more complicated fields of theory and practice such additional assumptions may be wide of the mark In other words, applied mathematics must, in the nature of things, transcend pure mathematics [2]

If we turn now to the social sciences do we find definitions postulates and theorems? Certainly we find a lot of statements, but which are the definitions, which the postulates and which the theorems? And which of the statements have to do merely with the conceptual scheme we are trying to set up, and which with those supplementary transitional propositions whereby we assert that in the particular practical situation which confronts us the elements of the conceptual scheme correspond adequately to the realities of the situation to enable us safely to assert that the application of the conceptual scheme to the actual situation is justified?

To take a special instance Is there any theory of money which does not appear to fly in the face of enough facts, which does not patently neglect enough possibly important variables of our economic (and psychological) system, which does not so much lean on secular trends as to render doubtful the feasibility of accomplishing by monetary manipulation that degree of economic control which some claim? Even if you can follow, as I can not, the logic of J M Keynes's Theory of Money,"[3] can you follow with conviction his transition to a system of regulation by manipulation of the bank rates or by large-scale governmental spending, or would you be tempted to give the citation 'J M Keynes dazzling terpsichorean, enricher of his College by war time speculation with her funds, now impoverishing a great republic by her adoption of his even more speculative theories ' The social sciences must become less enamored of the dazzle of the intellectual dance hall and more satisfied with the daily grind of work Maybe the long continued studies of our vice president, Mr Snyder, will help both with their findings and by their example [4]

I would not imply that there is no ascertained and widely agreed to body of knowledge in the social sciences, there is, at least in a general way, a larger amount of agreement and of demonstration than is commonly believed by those unfamiliar with the social sciences, but efforts at reducing the body of the subject to neater form are very necessary in order that all may have a clearer picture of that on which they agree and a sharper realization of the crucial elements in the disagreements which must ever be in evidence so long as the subject is alive and advancing [5] It is, I understand, the object of the Econometric Society to proceed along those lines The society will, however, be handicapped in its efforts unless it can draw a line between pure science and applied science The task will require patience, for a long time we shall

[2] "What is sometimes called 'applied' science, may then be more truly science than what is conventionally called pure science For it is directly concerned with not just instrumentalities, but instrumentalities at work in effecting modifications of existence in behalf of conclusions that are reflectedly purposed " From John Dewey, "Experience and Nature," p 161 (Not from the "People's Lobby ")

[3] See, among other references, John Williams, *Quarterly Journal of Economics*, 45 547–587, 1931, A H Hansen and H Tout, *Econometrica*, 1 119–147, 1933, K Rübner Petersen, *American Economic Review*, 24 595–602, 1934

[4] Carl Snyder, *Quarterly Journal of Economics*, 49 173–205, 1935

[5] That there are disagreements at the research frontier is well illustrated by R. A Millikan, SCIENCE, 81: 1935

have difficulty in limiting ourselves to proofs which have mathematical precision Moreover, there need be little correlation between the amount of formal mathematics used by the investigator and the substantial validity of the proof offered

It is a homely saying that the proof of the pudding is in the eating thereof For most practical purposes this may be a sounder proof than any based on the perusal of the recipe or on a chemical analysis of the constituents Many a recipe which ought to have made a fine pudding has resulted in one quite inedible

In many proofs we introduce the notions of cause and effect We do not often so speak in the composition of puddings, and the validity of a notion may be questioned In geometry we do not say that the base and the altitude of a triangle cause the area to be what it is We think merely of the three quantities, base, altitude, area, as connected by a certain relation In mechanics we no longer think that the force causes the motion, we have only concomitancy of variables In complex systems which depend on a multitude of variables connected by a variety of relations, often unknown, it is clear that the usual situation must be that any imposed change in one of the variables may be distributed widely through the system, if the system is in quasi-equilibrium, if it is a going concern, it will probably exhibit the characteristic of homeostasis,[6] in the terminology of Dr Cannon The analysis into cause and effect is more necessary when one comes to speak of control, for control consists in obtaining the desired effects (and avoiding undesired ones) through specific measures The element of the will enters, the individual or social will, and, with it, causation in a sense somewhat different from that in which it is attributed to non-willing nature It does not do to overlook such generalities in speaking of proofs in a practical world

My fundamental contention, then, is that proofs, truth and facts must be relative to our culture and conditioned by it, that for different purposes they must not only be different but may even be differently conceived, that science can not be all things to all men but must consist of some very special things to limited groups of specialists who deal with various questions of pure and applied science For our development we have to depend on the professional ethics and the professional discrimination of those small groups, they must not fool themselves or attempt to fool one another within a group as to what is a proof or as to what are the facts, it may be impossible for them to explain themselves truthfully to non specialists without departing widely from the strict canons of proof which they adopt among themselves

SCIENTIFIC EVENTS

THE NEW CHAIR OF ASTRONOMY AT THE ROYAL INSTITUTION

IN connection with the establishment of the professorship of astronomy at the Royal Institution, to which Sir James Jeans has been nominated, the London *Times* writes as follows

The year 1863 was the last occasion when a new chair was created This was for Dr (afterwards Sir Edward) Frankland, who was elected to a separate professorship of chemistry, while Faraday was still the Fullerian professor of chemistry Frankland's professorship lapsed after Faraday's death The other 'elected'' professorship in the institution at the time, that of natural philosophy, had been established ten years earlier, and was not so short lived It was created for Tyndall when he went to the institution in 1853, and since his retirement in 1887 has continued by election and reelection down to the present day

By their resolution to establish a new professorship, the members of the Royal Institution have exercised a privilege they have possessed since the foundation of the institution. A proposal for a professorship in astronomy was made and agreed to in 1811, but no appointment followed and the proposal was dropped But astronomy is by no means a new subject to the audiences at the Royal Institution It has appeared at intervals in the lecture lists and has been of particular interest to the sons and daughters of members for the first of the famous Christmas courses ''addressed to a juvenile auditory'' was given by Wallis in 1826 on an astronomical subject, and in later years Sir Robert Ball, Sir David Gill and Professor H H Turner became popular Christmas lecturers on astronomy

Sir James Jeans is already known to the children of the present members of the institution, for he gave the Christmas lectures of 1933 on ''Through Space and Time '' It is by these lectures that he satisfies the requirement of the by laws that a new professor must have delivered a course of lectures to the institution within two years previous to his election

Since Tyndall, three physicists of great distinction have held the professorship of natural philosophy at the institution and have also been, in turn, the Cavendish professor of physics at Cambridge The late Lord Rayleigh soon after his retirement from Cambridge accepted an invitation to the chair of the Royal Institution

[6] The effort to view the economic system of a country as a whole with the understanding that a multiplicity of well balanced measures is necessary to get and keep the balance of the system is well illustrated by Douglas Copland's ''Australia in the World Crisis '' Dr W. B Cannon's book is entitled ''The Wisdom of the Body.''

and held it until 1905, when he was succeeded by Sir Joseph J Thomson. The present professor, Lord Rutherford, took up the duties in 1921 The rules prescribed at the beginning of the institution for the election of professors are still followed and thus it is that Lord Rutherford as an "elected" professor must seek the suffrages of the members every year, while Dewar's successor in the endowed Fullerian professorship of chemistry, the present resident professor Sir William Bragg, does not do so

THE STRATOSPHERE BALLOON OF THE NATIONAL GEOGRAPHIC SOCIETY AND THE U S ARMY CORPS

THE completion of the gondola for the flight to the stratosphere planned for June under the auspices of the National Geographic Society and the U S Army Air Corps has been announced

The gondola, made in Midland, Michigan, of a magnesium alloy lighter than aluminum, has been shipped to Dayton, Ohio, where, at Wright Field, its equipment will be installed under the supervision of Captain Albert W Stevens and Captain Orvil A Anderson, the commander and pilot for the flight The gondola will then be shipped to Rapid City, South Dakota, from the neighborhood of which the ascent into the upper atmosphere will be made

The hollow metal ball is nine feet in diameter, the largest gondola yet designed for stratosphere exploration Last year's gondola was eight feet, four inches in diameter A level floor extends across the sphere a foot and a half above its lowest point, and on this the two balloonists will have ample room in which to move about and take care of their air conditioned, floating laboratory

The flight this year will make use of a balloon considerably larger than any heretofore built The giant bag now under construction in Akron, Ohio, will have a capacity of 3,700,000 cubic feet of gas

Utilizing the experience gained last year, when their 3,000,000 cubic foot balloon developed a tear and crashed in southern Nebraska, the sponsors of the flight have incorporated many improvements The most important difference will be the use of helium gas instead of hydrogen Helium can neither burn nor explode It is more expensive than hydrogen, however, and has never before been used in stratosphere exploration

CONFERENCE ON SPECTROSCOPY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

A THIRD special program on spectroscopy and its applications is to be held at the Massachusetts Institute of Technology this summer, culminating in a research conference to be held during the week of July 15 to 20 This conference, which is to be held in the George Eastman Research Laboratories, will comprise lectures and discussions on photographic photometry, absorption spectrophotometry, spectroscopic analysis of materials, biological and chemical effects of spectral radiation, spectroscopy of the extreme ultra violet, and astronomical applications of spectroscopy The meetings of the first day will be largely devoted to consideration of general spectroscopic problems of the metallurgist, chemist and biologist, on Tuesday and Wednesday the chief emphasis will be on specific applications of spectroscopy to biology and medicine During the latter part of the week applications of spectroscopy to astronomy will be emphasized, a portion of the program being held in collaboration with the Harvard Observatory Summer School

The research conference coincides with the conclusion of the summer school courses in practical spectroscopy and the meetings are open to all those interested An invitation is being extended to all properly qualified investigators, to make use of the facilities of the laboratory of spectroscopy in connection with their researches during such portions of the summer months as they may desire A bulletin giving further information regarding the entire summer program on spectroscopy can be obtained by addressing Professor G R Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge

FELLOWSHIPS OF THE CHARLES A COFFIN FOUNDATION

THE fellowships of the Charles A Coffin Foundation of the General Electric Company have been awarded to eight college students from widely separated sections of the country to enable them to pursue studies and carry on research which, without such financial assistance, they would be unable to undertake in educational institutions of their choice The fellowships are awarded annually to encourage and assist in the pursuit of research activities in the fields of electricity, physics and physical chemistry

Fellowships have been granted by the Charles A Coffin Foundation annually since 1922, when the foundation was created by the board of directors of the General Electric Company for the composite purpose of assisting deserving college graduates in post-graduate work, recognizing the achievements of electric power companies, and electric railway companies, and rewarding employees of the General Electric Company who each year advance the efficiency of the company or contribute by meritorious work to progress in the electrical arts Since 1923, the foundation has made available a total of $65,000 for fellowships This year there were seventy-three students who submitted applications to the committee of award

It is reported by the General Electric Company that sixty per cent of those men who five years or more

ago received Charles A Coffin fellowships already have achieved a reputation for distinct contributions to science Of the 45 men to whom these fellowships were awarded during the period 1923–1929, the names of 27 men are listed in the latest edition of "American Men of Science" At least ten of the group have attained national reputations, and some of them are already known internationally At least three quarters of the group of seventy two who received awards during the period 1923 to 1933 are now associated with universities or industrial organizations, carrying on research investigations

Charles A Coffin was one of the founders of the company, serving as its head for thirty years as its first president and as chairman of its board of directors He died in 1926

The committee on awards consisted of Dr Bergen Davis, of the National Academy of Sciences, C C Williams, of the Society for Promotion of Engineering Education and J Allen Johnson of the American Institute of Electrical Engineers The committee was assisted by Dr William D Coolidge and Dr Saul Dushman, both of the General Electric Research Laboratory

SCIENTIFIC NOTES AND NEWS

Dr Frank Dawson Adams, from 1894 to 1931 Logan professor of geology at McGill University, now emeritus professor and vice principal, has been elected an honorary fellow of the Geological Society of Edinburgh

The medal and certificate of award of the St Louis Medical Society has been presented to Dr Edward A Doisy, professor of biochemistry at the St Louis University School of Medicine, in recognition of his work on the estrogenic hormones and for the isolation and preparation of theelin Dr Philip Shaffer, professor of biological chemistry at the Washington University School of Medicine, made the presentation address

Samuel Louis Hilton, retail pharmacist of Washington, D C, has been awarded the Remington Honor Medal for 1935 in recognition of his many years of service to the profession which culminated this year with the completion of the American Institute of Pharmacy, national headquarters of the profession in Washington Mr Hilton has served as president of the American Pharmaceutical Association and chairman of the council and has been a member of the revision committee of the United States Pharmacopoeia and at present is treasurer of the pharmacopoeial convention

Raymond E Davis, professor of civil engineering at the University of California, was recently awarded for the second time in four years the Wason Medal given by the American Concrete Institute This award is made annually for the best paper on concrete presented to the institute during the year

Dr. Frank B Jewett, president of the Bell Telephone Laboratories, was guest of honor at the annual meeting on April 9 of the New York Chapter of the Alumni Association of the Carnegie Institute of Technology He spoke on the work of the Board of Trustees of the institute, of which he is a member

Dr. Hugh S Cumming, surgeon general of the United States Public Health Service, is among the alumni elected to membership in the Chapter of Sigma Xi of the University of Virginia Formal initiation ceremonies for the new members will be held on April 24, when Dr Ernest O Lawrence, professor of physics and director of the radiation laboratory at the University of California, will give the annual Sigma Xi address

The William Mackenzie Medal for 1935 'for original contributions to ophthalmology of outstanding merit' has been awarded by the custodians, the Glasgow Eye Infirmary to Dr Ida C Mann The medal will be presented on June 7, when Dr Mann will describe her work

Nature reports that at the meeting of the Australian National Research Council at Melbourne, the first award of the Lyle Medal was made the recipient being Professor J R Wilton Elder professor of mathematics in the University of Adelaide This medal is to be awarded at intervals of two years, to workers in Australia for such researches in mathematics or physics as may appear to the council most deserving of such honor, the period covered being the five years preceding each award

At a recent meeting the Cleveland Academy of Medicine has awarded the title of honorary secretary for life to Dr Jacob Edward Tuckerman in recognition of thirty three years of continuous service to the academy in various capacities Dr Howard Lester Taylor, president, presented to Dr Tuckerman an illuminated parchment on which was inscribed the action of the society and Dr George E Follansbee paid tribute to his long service

The University of Cincinnati Section of Sigma Xi has elected the following officers *President*, Dr Charles N Moore, professor of mathematics, *vice-president*, Dr John H Hoskins, associate professor of botany, *secretary treasurer*, Dr Saul B Arenson, associate professor of chemistry

DR HENRI HARTMANN, professor of clinical surgery at the University of Paris, has been elected vice president of the Paris Academy of Medicine

DR E B FORBES director of the Institute of Animal Nutrition of the Pennsylvania State College, is visiting the agricultural experiment stations in Illinois, Minnesota Missouri, Arizona and California He spoke before a joint meeting of the Missouri chapters of the honor society of agriculture, Gamma Sigma Delta, and the Society of the Sigma Xi on March 19 on Conditions Affecting the Utilization of Feeding Stuffs'

DR URAL S ASHWORTH instructor in agricultural chemistry at the University of Missouri, has been awarded the Alexander Brown Coxe Memorial Fellowship in biological science at Yale University Dr Ashworth will continue his work on the composition of the body as it affects endogenous metabolism

THE committee on scientific research of the American Medical Association has made a grant to Dr Roy H Turner, assistant professor of experimental medicine at Tulane University, to aid in studies of physiology in peripheral blood vessels in man The David Trautman Schwartz Research Fund and the Josiah Macy, Jr, Foundation are also contributing towards the support of the researches of Dr Turner and his associates

AT the forthcoming meeting of the Pacific Division of the American Association for the Advancement of Science, Dr K F Meyer, director of the Hooper Foundation of the University of California, will make an address on June 27 on 'Plague—Past and Present '

THE James Arthur Lecture on the evolution of the human brain will be delivered on April 25 at the American Museum of Natural History, New York City, by Professor C U Ariens Kappers, of the University of Amsterdam

DR GUIDO BECK, recently appointed professor of theoretical physics and director of the Institute of Theoretical Physics at the University of Odessa, U S S R, lectured at the University of Oklahoma on April 5 and 6 His subjects were "The Theory of the Positive Electron" and "The Theoretical Treatment of the Radioactive Beta decay" Dr Beck is at present visiting professor at the University of Kansas

DR. GEORGE E UHLENBECK, professor of theoretical physics at the University of Michigan, recently gave three graduate lectures at the State University of Iowa These were "Statistical Energy Distributions for a Small Number of Particles, with Special Applications to Disintegration Problems", "The Theory of β ray Radioactivity" and "The Stability and the Interaction of Proton and Neutron"

PROFESSOR A E DOUGLASS, of the University of Arizona, gave a lecture on March 30 at the University of Kansas City before a joint meeting of the Kansas City Section of the American Meteorological Society and the Sigma Xi Club of Kansas City His subject was 'Annual Rings in Trees and Long Range Weather Forecasting"

PROFESSOR NELS A BENGTSON, chairman of the department of geography of the University of Nebraska and president of the Nebraska Academy of Sciences, will lecture during the summer session of Columbia University He will give courses in economic geography and will conduct a special seminar in geography

THE tenth International Congress of the History of Medicine will be held in Madrid from September 23 to 29, when the subjects for discussion will be Arabian medicine in Spain medicine in America during its discovery and colonization, and medical folk lore in various civilized countries

Industrial and Engineering Chemistry reports that the fourth International Congress of Agricultural Industries, which is to be held in Brussels from July 15 to 27 in connection with the Universal Exposition of 1935, is being organized by the International Commission of Agricultural Industries The third congress was held last year, at Paris and although intervals of three years between the congresses will ordinarily be observed, it was decided to hold the fourth congress in 1935, in order to set up a more effective organization of the congresses and take advantage of the Brussels exposition The congress will be organized in four divisions general scientific studies, agronomic studies, industrial studies and economic studies There will be some twenty-six sections comprised in these four general divisions In order to assure discussions of timely interest, special reporters upon ten such topics will be appointed, and the reports prepared by them printed and distributed in advance in order to assure fruitful discussion of these questions of priority Applications for membership and for further information should be addressed to the International Commission of Agricultural Industries, 156 Boulevard Magenta, Paris (X^e), France

ACCORDING to *Nature*, at the next General Assembly of the International Astronomical Union, to be held at Paris from July 10 to 17, the French National Committee of Astronomy is arranging an exhibition of astronomical documents and apparatus, to exhibit the principles and the details of application of the methods of observation employed The examination

of actual instruments shows better than any description how they are applied, while original negatives or positives on glass will enable the quality of the results obtained to be judged The exhibition will enable astronomers to examine the documents serving as the foundation of the astronomical discoveries of the present century It is particularly hoped that auxiliary apparatus and accessory contrivances of all kinds will be exhibited by observatories and instrument makers such instruments are micrometers chronographs, photometers, spectrographs, driving motors, observing sheds and seats abacuses numerical tables and calculating machines Inquiries can be addressed to M le Comte de la Baume Pluvinel or to Professor C Fabry at the Paris Observatory

A CORRESPONDENT writes "The annual banquet and dance of the Botanical Society of Washington, D C, was held on April 2 in the ball room of the Kennedy Warren with an attendance of 187 After the dinner, Dr Wm H Weston, Jr, professor of cryptogamic botany at Harvard University, gave an illustrated lecture on 'Sex in the Lower Fungi' A most amusing, well executed farce was presented by members of the society, the outstanding feature of which was the original poetry read by Dr L H Flint"

GUEST speakers at the annual convocation on May 3 and 4 of the Nebraska Academy of Sciences which will be held at the University of Nebraska, will be Dr Victor Levine, of Creighton University, and Dr J B Kincer, chief of the division of climate and crop weather of the U S Weather Bureau The subject of Dr Kincer's address will be 'Man and His Climate with Special Reference to the Great Plains"

THE Virginia Academy of Science will hold its thirteenth annual meeting at the University of Richmond, Virginia, on May 3 and 4 One hundred thirty five papers will be read and discussed in the sections of astronomy, mathematics and physics, biology, chemistry, geology and the medical sciences Dr Alexander Wetmore, assistant secretary of the Smithsonian Institution in charge of the U S National Museum, Washington, will be the principal speaker at the general session of the academy His subject will be 'Explorations in Hawaii"

ACCORDING to *The Museum News* the Washington meeting of the American Association of Museums will be held for three days beginning on May 23 There will be general sessions in the mornings with a more than usually varied list of speakers, and sectional conferences on one afternoon and two evenings The meeting will end on Saturday with a trip of four hours on a chartered Potomac steamer A similar feature years ago gave opportunity for getting acquainted and for informal discussions There will be one free afternoon to visit the museums of Washington The Southern Museums Conference will be held on May 22, the day before the opening meeting of the association The headquarters hotel The Willard, offers rooms at rates from $2 00 to $6 00 a person Reservation cards, with full details, will be mailed to members

THE department of geology of the University of Wisconsin will conduct its biennial field trip in the pre Cambrian area of the Lake Superior region from May 17 to 26 The trip will be under the direction of Professors C K Leith and Andrew Leith

THE seventh Smithsonian anthropological and archeological expedition to Alaska, under Dr Aleš Hrdlička, will leave Seattle on May 18 The excavations, as during the two preceding seasons, will be on the Kodiak Island As on his previous trips, Dr Hrdlička will be accompanied by a party of volunteer college students who with him will carry on the excavations These students receive aside from the field training, a course of tri weekly lectures on the human skull and skeleton, on general anthropology and on the principles of American archeology No charge is made for this instruction, but the students pay their own expenses Due to the limited accommodations the number of students for the coming season must be limited to eight There are still two vacancies Applications should be made to Dr A Hrdlička, U S National Museum, Washington, D C

THE council of New York University has approved the change in name of the medical school of the university from New York University and Bellevue Hospital Medical College to New York University College of Medicine

APPLICATIONS for the positions of associate engineer and assistant engineer in soils mechanics must be on file with the U S Civil Service Commission at Washington, D C, not later than May 6 The entrance salary for the associate grade is $3,200 a year, and for the assistant grade, $2 600 a year These salaries are subject to a deduction of 3½ per cent toward a retirement annuity The duties are to make or supervise the making of soil tests to determine coefficient of cohesion, angle of internal friction, time and amount of consolidation, coefficient of permeability, etc, to devise and supervise the design of apparatus and equipment necessary for the testing and procurement of representative samples of soils and subsoils, and to analyze data and prepare reports on the condition and nature of soils and sub soils as engineering and foundation material Specified education and experience are required

THE *Journal* of the American Medical Association reports that by the will of the late Walter G Ladd,

the following bequests will become effective after the death of his widow Somerset Hospital, Somerville, N J, $100,000, Elizabeth General Hospital and Dispensary, Elizabeth, N J, $25,000 The remainder of the estate, about $10,000,000, will be divided into three trust funds one to maintain the family estate in New Jersey as a convalescent home for "deserving gentlewomen," one to aid such persons elsewhere and the third to be used for hospitals, medical schools, universities, colleges and similar institutions 'not existing for pecuniary profit" At the end of fifty years, the trusts are to be terminated and the principal will be divided among several institutions, including the New York Post Graduate Medical School and Hospital and the Johns Hopkins Hospital

THE University of Cambridge, England, has received a gift from Dr G P Bidder, of Trinity College, to be used for a ten year period for the benefit of occupants of the Cambridge table at the zoological station in Naples It has also received a grant of £5,500 from the Goldsmiths' Company for an investigation of the alloys of silver to be carried out under the direction of Dr R S Hutton professor of metallurgy, Clare College, Cambridge

Nature states that two new research laboratories are to be built for the Council for Scientific and Industrial Research of Australia, using money voted for relief of unemployment One, at a cost of £6,000, will replace an existing small building at the Council's viticultural research station near Mildura on the River Murray, where investigations into problems of the dried grapefruits industry have been in progress for many years The other will house the Forest Products Division, which hitherto has carried on in temporary quarters in Melbourne The new laboratory, to cost £25,000, will be in the midst of the city's timber yards, and this should mean decided increase in the practical effectiveness of the division's work

ALLOTMENT of $7,500 of Hawaiian sugar processing tax funds for the purpose of initiating a soil survey in the Territory of Hawaii has been made in an order which has been signed by Secretary of Agriculture Wallace and approved by President Roosevelt The purpose of the survey is to secure comprehensive data on the adaptability of soils in various areas in the territory, particularly to serve as a guide in the use of land for crop diversification The survey has been recommended by the Hawaiian Agricultural Advisory Committee appointed by the Secretary of Agriculture The Bureau of Chemistry and Soils of the Department of Agriculture, which will collaborate with the University of Hawaii, has been placed in charge of the technical work of the proposed survey

DISCUSSION

THE SIGNIFICANCE OF FOOD HABITS RESEARCH IN WILD LIFE MANAGEMENT[1]

THE term "wild life management' has taken on a meaning somewhat distinct from the older 'conservation,' in that it implies a less passive technique It lays more emphasis upon the improvement and maintenance in an improved condition of environment for wild species and not so much upon the provision of sanctuaries and legal protection This change of emphasis is entirely consistent with modern ecological thought Meager as our knowledge may be, we are no longer so prone to assume that species may thrive in habitats unsuited to them, even if permanently protected against persecution by man

Wild life management, as the term is used here, is not artificial propagation, it is the encouragement of wild creatures under conditions as nearly natural as possible It does not inevitably follow that management of a species is synonymous with encouragement, though it commonly does Broadly, management is human manipulation of wild populations and may be motivated by economic, esthetic or scientific objectives

The earlier efforts at management were, as might be expected, characterized by a great deal of blind groping[2] This handicap has not been wholly removed from modern management either, for two chief reasons In the first place wild life management is beset by a formidable array of cherished popular prejudices which yield to contrary evidence with extreme slowness, if at all Secondly, there is still a real deficiency in basic information on ecological questions

While it may doubtless be said that many of the latter questions are unanswerable, it may be said with equal truth that many are so elementary and pertinent in relation to wild life management that their continued neglect does not flatter our sense of perspective Intermediate between questions of these two extreme types, complex and simple, are a host of others, significant alike to pure and to applied science, at least some of which should prove amenable to investigation

One of the most fundamental phases of ecological research pertaining to wild life management is the study of the food habits of animals This should not

[1] Journal Paper No J219 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project No 329

[2] Aldo Leopold, "Game Management," pp 3–21. *Scribner's*, 1933

be confined solely to the identification of what animals eat, however deficient our knowledge may still be even in that respect Our knowledge of the general food habits of lower vertebrates is inadequate for immediate needs, and this is also true for many birds and mammals of obvious economic importance

General food habits studies constitute a necessary groundwork for the more specialized research that may profitably follow The most useful single technique for extensive investigation at present seems to be that of stomach examination, supplemented by or combined with, whatever field observations and fecal or pellet analyses may be advantageous Frequently emphasis may be placed upon one of the minor techniques in the attack of specific problems, such as pellet analyses for the study of some owls [3]

Great as may be our immediate need for vastly more general food habits data, probably greater needs may be served by diversification and intensification of food habits investigations The realization of these potentialities should be of extreme significance to the progress of ecological science as a whole as well as to that particular branch known as wild life management

In planning management of any species, not only do we need to know what it eats, but also what foods it has access to, especially under changing conditions We need to know more about what determines availability of foods more about the influence of adaptations, experience, preferences and physiological demands on feeding tendencies of animals and about what foods are essential to the existence of a species and what are incidental or conceivably detrimental

The sound administration of a waterfowl or shore bird or any other sort of wild life refuge is dependent on adequate information on these points The refuge may provide proper food for the desired species but it may not Perhaps something may reasonably be done to correct food deficiencies, perhaps not At any rate, the wild life administrator is not likely to find it to his disadvantage to know something about what he is trying to do, and on many subjects he can know only through the research of others

Understanding of the basic problem of predation, of which we have very great need, involves intensive research on food habits and on factors governing food habits of predatory species Stimulation of local research would be particularly in keeping with the growing trend in conservation thought toward the conclusion that enlightened and truly effective predator control should attempt far more than at present to make game, poultry, etc, difficult for predators to get rather than to attempt great reduction in numbers by drastic campaigning against the predatory species themselves

Here, too, we need to know much more than what a species may eat What are the adaptations of a predatory species for capturing and handling prey and what are the adaptations of the prey for defense or escape? What factors importantly affect the relative security or vulnerability of prey? What difference does predation actually make to the prey species, anyway? The fact that a species suffers a certain amount of predation—even conspicuous or heavy predation—does not necessarily mean that it is controlled or that its population levels are appreciably affected thereby [4]

Work in this general direction is gradually gaining headway through the activities of a number of colleges and universities some of the more advanced state fish and game departments and other private or public agencies Agricultural colleges have recently displayed increasing recognition of the opportunities for constructive programs centering about local researches on specific wild life problems and in several instances have been making adjustments as rapidly as their budgets have permitted

The Division of Food Habits Research of the U S Biological Survey has participated creditably in practically every substantial movement of consequence to wild life management in the country despite its small staff and limited funds It seems more than a little ironical that this division with its highly trained personnel, its unmatched reference collections and its strategic possibilities as an ecological clearing house should be the perennial target of crippling economies, with occasionally its very existence threatened

In short from the standpoint of one interested in wild life management and foreseeing the great development that will surely occur it is apparent that the necessary supporting researches into the food habits of organisms are barely entering the tremendous field of significant endeavor that awaits Continued progress may call for refinement and elaboration of techniques and for a greater breadth of vision on the part of the workers but not less for greater understanding and appreciation on the part of the public The intrinsic value and promise of the science alike are boundless, and support for it should be forthcoming in generous measure

Paul L Errington

Iowa State College

MASTODON AND OTHER REMAINS AT AURORA ILLINOIS

Finding of mastodon parts and other material during recent months will contribute items of interest

[3] Paul L Errington, *The Condor*, 34 75–86, 1932

[4] Paul L. Errington, *Ecology*, 15 2, 110–127, 1934

regarding the life of this vicinity in early post glacial times The finds were made by CWA workers while digging for an artificial lake in a swamp in Phillip's Park, which is located in the southeast part of Aurora, Illinois

The mastodon parts consist of three skulls, one of which includes the lower jaw, three tusks, a femur, an ulna, a scapula, a number of ribs, several vertebra and a number of foot bones Most of the material is in excellent preservation E S Riggs, paleontologist at the Field Museum of Natural History in Chicago, has identified the species as being *Mastodon americanus* There were also found in the same formation as the mastodon material three pairs of bird humeri and a portion of breast, all of the same species of bird Identification has not yet been made of the bird specimens, but they are being examined by Professor L A Adams, of the University of Illinois The size suggests a bird possibly four feet in height

The deposit in which the mastodon and bird material was found is a bed of gray marl enclosed on three sides by hills of glacial till, and situated a mile and a half east of the Fox River Professor William E Powers, of Northwestern University, has examined the geological features of the locality, and believes that the marl represents a post glacial lake which probably once connected with the river A series of borings made in a north and south line across the marl bed revealed a maximum thickness of thirty feet Overlying the marl was a layer of peat varying in thickness from two to five feet and over this about two feet of black muck which comprised the bottom of the modern swamp The mastodon and bird skeletal parts were found in the upper three feet of marl, with the exception of the scapula which was in clay at the margin of the marl bed This was the first specimen found, and obscurity of reports as to exact locality do not justify definite conclusions as to whether it differs in age from the rest of the specimens

A hemlock cone found in the cavity of one of the mastodon tusks has been identified by Dr W T McLaughlin, of Northwestern University, as being of the species, *Tusga canadensis* Several other cones found in the marl of the same vicinity, he considers to be of the same species There were also found two cones which he considers to be apparently black spruce, *Picea mariana*.

Professor F C Baker, of the University of Illinois, has identified twenty one species of shells in a sample of the marl sent to him by Professor Powers Baker reports[1] that "it is, as far as climate is concerned, a cold temperate fauna" He also states that it is "quite like the marl fauna found a few years ago in the bottom of Green Lake, Wisconsin, which is certainly middle Wisconsin in age, not later" He considers the cones of hemlock and spruce as further indication of a cold temperate climate

[1] Personal communication to William E Powers

Another find of interest was a right femur of the giant beaver, *Castoroides ohioensis*, the specimen being identified by Professor Adams It was reported by workmen to have been found in the peat layer, but there is reason for believing that this may be an error and that the specimen was more likely in the marl

In the peat layer quite a collection of mammal skeletal parts has been found and most of it examined by Professor Adams. Most frequently represented is the Virginia deer A skull he has identified as that of a female elk The most recent find in the peat layer is a skull apparently of a muskrat This has not yet been studied in detail

With the completion of the lake digging project the finding of specimens has now come to an end Much remains to be done in studying the specimens and the data which has been recorded, and plans are under way by which it is hoped that more detailed reports will later appear in the scientific literature The city of Aurora is keeping the specimens on display in a museum at Phillip's Park

CLARENCE R SMITH
AURORA COLLEGE

LONGEVITY IN THE BOX TURTLE

IN the summer of 1896 a box turtle (*Terrapene carolina*) was captured on my father's farm in Ohio This specimen had a carapace 6½ inches in length There was a small round hole through edge of the shell about midway of the arc between the forefoot and the neck On the back, slightly off the midline to the left, was an irregular scar approximately an inch in diameter, apparently produced by burning, as the contour of shell was not distorted, as would be the case if due to a blow or crushing Partly merged with this were two letters, one an R, the other unidentifiable These letters had evidently been carved, but at that time the markings had the appearance of stippling or pitting, the instrument cuts being almost completely obliterated

There were two other sets of initials identifiable as those of two men of the neighborhood Later it was recalled by others that these two men had been seen to carve their initials in the shell of a turtle 16 or 17 years before Testimony differed on the exact time One of these men had been dead nearly 16 years

Comparison of these letters with the older ones would lead one to conclude that the latter must have been placed there many years earlier The outline of

the R was not distorted, as might have been the case had the animal grown after the carving was done

By means of the hole mentioned, the animal was tied up in the yard and kept until the approach of cold weather, when it was released It was found again the following year about 300 feet from the house and has been recaptured at frequent intervals since, the last time in the late summer of 1933 Neither its size nor appearance had altered in the intervening 37 years, except that there is some indication of pitting in the second set of letters

A total of 53 years of this turtle's life may be accounted for quite accurately The animal was certainly well grown when the first letters were carved There is no doubt that they *were* carved originally, because when captured in 1896 there were instrument cuts still visible The question arises as to whether the pitting is an evidence of a healing process and therefore related to the age of the cuts

The later set of carvings showed no evidence of pitting in 1896 but when observed by the author in 1932 had begun to pit—about 50 years after they were made This fact suggests that the pitting bears a general relation to the age of the wound If so, the condition of the earlier carvings would indicate that they were much more than 50 years old in 1896, unless the process takes place more rapidly in the shell of a young animal

In none of the literature cited below was there found any reference to pitting in similar carvings although some of them were more than 50 years old Whether they were not present or were not noted can not be determined

If one allows 5 years for growth to adult size, and 20 years for the repair processes in a young turtle, this brings the total estimated age to 78 years in 1933 Unless the significance of the markings is greatly misinterpreted, this would seem to be a conservative estimate of this turtle's age

An incomplete survey of the literature reveals the following records which seem to be quite authentic Deck,[1] 88 and 87 years, Medsger,[2] 35 years, Koch,[3] 32 and 41 years, Nichols,[4] 78 years, Flower,[5] various species confined in zoological gardens, maximum 42 years, Townsend,[6] 35 and 40 years

C I REED

UNIVERSITY OF ILLINOIS
COLLEGE OF MEDICINE

RESULTS OF GOITER PROPHYLAXIS WITH IODIZED SALT

WHILE visiting Switzerland Dr Hans Eggenberger took me all over the canton of Appenzell and allowed me to examine the school children to show the results of 11 years of iodized salt The results were truly remarkable and perhaps American readers will be interested in the conclusions which Dr Eggenberger presented to the Second International Goiter Congress at Bern, August, 1933, and communicates to me in a letter

(1) Iodine in very small quantity is a food

(2) Of all kryptotrophic elements of the human body, iodine is the first of which we now know the necessary quantity for daily use This is about 1 or 2 γ for every kilogram of body weight (γ = microgram the millionth part of a gram)

(3) If the average daily intake is under 1 γ/kg in any part of the world, the danger of goiter in man exists

(4) If the average intake is near 2 γ there is no danger at all of goiter, even though the susceptibility to goiter is increased by infectious disease or high fat or high cabbage diet

(5) Experiments to show freedom from goiter without sufficient iodine supply have often been made without chemical analysis of iodine intake

(6) The extended natural comparative studies in Switzerland (v Fellenberg), Holland (Reith) and U S A (McClendon) and the most successful results of prophylactic measures against goiter in Appenzell prove that goiter is indeed a symptom of iodine deficient disease, what Marine, Kimball, Lenhart and others have proved long ago Goiter can easily be avoided with iodine in the salt, in the proportion of 1 100,000 for daily use

J F MCCLENDON

UNIVERSITY OF MINNESOTA

SOCIETIES AND MEETINGS

THE NEW ORLEANS ACADEMY OF SCIENCES

THE New Orleans Academy of Sciences held its eighty second annual meeting at Tulane University on Friday and Saturday, March 15 and 16 The meeting was divided into five sections, at which 39 papers were presented, as follows Physics, Engineering, Mathematics, Astronomy and Geology, 12, Chemistry, Biochemistry and Chemical Education, 8 Biological Sciences, 9, Medical Sciences, 4, Social Sciences, 6 The total attendance at the section meetings was approximately 550

On Friday night E L Demmon, director of the Southern Forest Experiment Station, U S Depart-

[1] R. S Deck, *Copeia*, p 179, 1927

[2] A. P Medsger, *ibid*, p 29, 1919

[3] E G Koch, *Forest and Stream*, p 170, 1907

[4] J T Nichols, *Copeia*, p 66, 1917

[5] S S Flower, *Proc. Zool Soc London*, p 911, 1925

[6] C H Townsend, *Bull N Y Zool Soc*, Vol 27, p 98, 1924

ment of Agriculture, gave an illustrated public address on "The Social Aspects of Forestry in the South"

The session on Saturday morning was devoted to a symposium on 'Stimulation of Scientific Interest at the Level of the High School,' under the sponsorship of the recently organized Junior Academy Section of the New Orleans Academy On Saturday night Dr A B Cardwell, of the Tulane University Department of Physics, gave a demonstration of the properties and effects of liquid air before a large audience of high school science students, as a part of Junior Academy activities

The total attendance at all meetings was more than 800

At the business meeting Dr Rudolph Matas and Dr Brandt Van Blarcom Dixon, both past presidents of the academy, were unanimously elected honorary members, by elevation from the rank of regular member Twenty eight new regular members were also elected The officers elected for the coming year are F L Demmon, United States Forest Service, *President* Dr H H Beard, Louisiana State University Medical Center *Vice President,* Philip C Wakeley, U S Forest Service, *Secretary,* Dr D S Elliott, Tulane University, *Treasurer*

PHILIP C WAKELEY,
Secretary

THE OKLAHOMA ACADEMY OF SCIENCE

THE twenty third annual meeting of the Oklahoma Academy of Science was held at the University of Oklahoma Norman, on December 7 and 8 The academy program was divided into four sections which were as follows Biology, Geology, Physical Sciences and Social Sciences One hundred and twenty two papers were presented A special section was arranged for high school science teachers

Chancellor E H Lindley, of the University of Kansas gave the annual address on Friday evening in the University Auditorium The subject of this lecture was "Science Confronts Two Worlds" Dr Lindley spoke again on Saturday morning on "A New Frontier"

Dr Frank G Brooks gave the presidential address after the luncheon on Saturday His subject was "The Place of the Physical and Biological Sciences in the Liberal Arts Curriculum"

More than 300 people were present at the meetings The officers elected for 1934–1935 were as follows

President Dr C E Decker, University of Oklahoma, Norman
Vice president, Section A (Biology) Dr John G Mackin, East Central Teachers College, Ada
Vice president, Section B (Geology) Elmer L. Lucas, Phillips University, Enid
Vice president Section C (Physical Sciences) Mrs E S Hammond, Oklahoma College for Women, Chickasha
Vice president, Section D (Social Sciences) Dr J T Sanders, Oklahoma A & M College, Stillwater
Assistant Secretary Treasurer Dr Geo Van Lear, Oklahoma University Norman

HORACE J HARPER,
Secretary

THE SOUTH CAROLINA ACADEMY OF SCIENCE

THE South Carolina Academy of Science held its twelfth annual meeting at the University of South Carolina on April 6 The meeting was well attended and the secretary reported that the membership of the academy had been doubled within the last two years The meeting next year will be at Winthrop College, Rock Hill At the business meeting of the session, the following officers were elected for the ensuing year

President Professor Franklin Sherman, Clemson Agricultural College
Vice president Professor A C Carson University of South Carolina
Secretary Treasurer J E Copenhaver, University of South Carolina.
Executive Committee Professor J A Osteen, Furman University Dr F W Kinard, Medical College of South Carolina Dr W W Rogers, Winthrop College.

J E COPENHAVER,
Secretary and Treasurer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A COMMUTATOR FOR THE HARVARD KYMOGRAPH[1]

A NEED was felt for a dependable circuit breaker that could be attached to a kymograph without necessitating tearing it apart each time it was to be used Previous attempts at using various makeshift "trigger" attachments led to the construction of the apparatus described here

In many physiological experiments it becomes desirable to stimulate a preparation at exactly the same location of the drum at each rotation In others, a key that will be automatically opened or closed on the swiftly moving drum is often advantageous Also in a great number of routine experiments in which the

[1] From the department of physiology, Purdue University, Lafayette, Indiana

single throw key is used, the wiring can be simplified by the use of a commutator attached to the kymograph For example, in the fundamental experiment of determining the phases of a single muscle twitch, the use of the commutator obviates the necessity of the signal magnet to mark the point of occurrence of the stimulus After the twitch has been recorded on the revolving drum the point where the stimulus entered can be shown quite easily on the same record by turning the drum around to a point just preceding that of entry of the stimulus Now if the drum is run at its slowest speed until the contact is made, the muscle will again contract and thus mark the point of entry of the make or break shock Also the arc of the muscle lever will be recorded so that errors due to it can be compensated for on the original record Thus the commutator simplifies the above experiment by reducing the electrical wiring eliminating the signal magnet and its additional 'scratch marks," and giving a single tracing for the muscle twitch and the occurrence of the impulse, besides picturing the arc of the muscle lever In many other experiments simplification of wiring and more positive electrical contacts can be produced

The construction of the commutator is as follows A brass collar (1, Fig 1) of slightly greater diameter

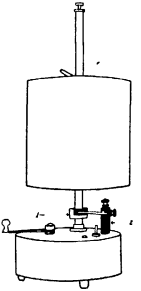

FIG 1

than the base of the upright stand is fastened to the shaft of the drum by a countersunk set screw One half of the circumference of this collar is insulated by an inset piece of bakelite Then the collar is turned and polished to insure good edges since these are necessary for perfect contacts All metal parts can be plated to give a more pleasing effect, if so desired A bakelite binding post (2, Fig 1) is then mounted in place of one of the three machine screws found on the top of the base of the kymograph A long machine screw passes into this base and affords the "ground" contact The upper end of this machine screw is fitted with nuts which hold the post in position and serve as a binding post

The second contact consists of a strap of brass bound around the bakelite post and making a sliding contact with the collar (1) A slight tension of the brass strip affords a good contact and in no way impedes the turning of the drum If the commutator is not to be used the bakelite post (2) can be turned slightly to disengage the strap from the rotor For the sake of simplicity in the accompanying diagram the stop lever and fan have been omitted from the sketch, although they do not interfere with the apparatus in any way

By varying the position of the secondary coil of the inductorium, threshold make and break shocks can be obtained, and thus one or two stimuli per rotation of the drum can be had at will

The author acknowledges the assistance of the university technician, W E Fish, in the designing and constructing of the commutator

WM A HIESTAND

MENINGOCOCCUS PRECIPITATING ANTIGEN FOR ROUTINE TESTING OF THERAPEUTIC SERUMS[1]

ONE of the generally used methods of standardizing the potency of anti meningococcus therapeutic serums is the determination of their precipitating titers It is therefore necessary to have a highly specific antigen and one that could be kept for a long time without appreciable deterioration After considerable experimentation with different preparations, the following preparation gave us the desired results

Meningococcus cultures of standard types are grown on 0 5 per cent glucose beef heart agar, pH 7 2 to 7 4 Several successive transplants are made at 24 hour intervals Then a 24-hour growth is scraped into sterile physiological saline, the suspension is shaken by hand and filtered through a thin layer of sterile absorbent cotton to eliminate particles of agar that may have been carried over The filtered saline suspension of the cocci is centrifuged at high speed until the cocci are precipitated The supernatant fluid is discarded and the cocci are suspended in sterile distilled water, using ten times the volume of water to each volume of packed cocci To this 10 per cent of commercial antiformin is added and the mixture is placed in boiling water until the cocci are

[1] From the Bureau of Laboratories, New York City Department of Health, Director, Dr Wm H Park.

dissolved—usually 10 minutes The solution is centrifuged for 30 minutes at high speed, and the clear supernatant fluid is added drop by drop to 95 per cent alcohol in 50 cc centrifuge tubes using 1 cc of the supernatant fluid to each 20 cc of alcohol, a precipitate forms immediately The tubes are centrifuged for 5 minutes at low speed, the alcohol is poured off and the tubes are filled with 95 per cent alcohol which contains 0 2 per cent HCl The sediment usually adheres to the sides and bottom of tubes This should be scraped by means of a pipette and thoroughly mixed with the acid alcohol, care should be taken to break up large clumps This is centrifuged for 5 minutes, the acid alcohol poured off and the sediment washed twice in 95 per cent alcohol, using the same procedure as above After the final washing, the alcohol is drained off and the sediment dissolved in saline, using 10 times the amount of the original packed cocci The sediment dissolves readily in the saline, and in order not to lose any of the sediment, the necessary amount of saline is added to the centrifuge tubes The solution is then collected and placed in sterile centrifuge tubes and heated in boiling water for 20 minutes It is then centrifuged for 30 minutes at high speed and the clear supernatant fluid collected aseptically into small sterile vials and stored in the ice box

The antigen is standardized by testing with known homologous and heterologous serums, using various dilutions of the antigen and the optimum dilution of the antigen is determined by repeated tests This dilution is then used as the standard dilution for the routine testing of the antimeningococcic serums

The antigen can be kept almost indefinitely when stored at 8 to 10° C Care should be taken not to contaminate it We have been using antigens prepared according to this method for the past several years in testing our therapeutic serums, also to follow the response of the horses during the process of immunization, and found the antigens stable and highly specific

LUCY MISHULOW

SPECIAL ARTICLES

INVESTIGATION OF OVERTHRUST FAULTS BY SEISMIC METHODS[1]

IN the great mountain belts the earth's crust has been severely buckled and fractured, apparently mainly by horizontal compressive forces Of the various types of folds and faults that developed in the course of this deformation the enormous overthrust faults are among the most important and interesting Along these horizontal or gently sloping fractures huge slabs of the crust ranging from thousands of feet to miles in thickness have been thrust forward for distances of miles and sometimes for many tens of miles The length of these faults, traced along the surface, is from tens to hundreds of miles Their extension backward and downward into the crust is presumably of comparable dimensions, but in view of the limited thickness of that part of the crust which has suffered mountain making deformation, it is unlikely that the depth to which they reach exceeds a few tens of miles On our own continent the Rocky Mountains of the northern United States and of Canada have been thrust many miles eastward over the margin of the Great Plains along such overthrust faults In the southern Appalachians each of the several slabs shown in any cross section has ridden westward over its neighbor In the Alps and in the Highlands of Scotland overthrusts on a tremendous scale have been recognized

Until the shape of the fault surfaces is known it will be very difficult to gain an understanding of the mechanics of the overthrusting process Suppositions regarding their form have ranged from convex upward to concave, Longwell has suggested that the presumable convexity of the portion near the trace may change to concavity farther back under the plate It has been difficult, however, to ascertain the three dimensional form of these remarkable structures, since observation of them is limited to the trace—the intersection of the fault surface with the land surface—and to occasional fensters or windows where a stream has cut through the overriding plate to expose the undermass Clearly it is desirable to gain any information possible regarding the shape of the fault surface, or of any part of it back of the trace So far as known, no previous attempt has been made to secure such data for great overthrusts by utilizing seismic reflections The experiment was tried only after several years' experience with the method and after considerable success through its use had been attained in determining folded structures in stratified formations

Elastic waves in the crust of the earth are reflected when they encounter a surface between two layers or bodies in which the waves are propagated at different

[1] Contribution 164 of the Balch Graduate School of the Geological Sciences, California Institute of Technology, Pasadena

velocities. In most applications of seismic methods to stratified rocks the velocity in the layer above the reflecting surface is lower than that in the layer below it, but in the case of great overthrusts the velocity in the upper layer is usually the higher.

Individual strata a few feet or even a few tens of feet in thickness do not reflect the waves; a layer must be about a wave length in thickness, *i.e.*, of the order of 100 feet, to cause strong reflection. Only if the instruments are located a long distance from the shotpoint does less reflected energy reach them when the high velocity rock is on the upper side of the reflecting surface.

As a consequence of the usually reversed velocity relation in overthrust plate and undermass, waves passing the boundary surface into the undermass of lower velocity are *refracted* back toward the surface only at distances too great for observation. Consequently, it is usually not possible to utilize the so-called *refraction* method for the investigation of the thickness of overthrust plates. The *reflection* method is effective in this case, however, for the intensity of a *reflected* wave, if its path meets the boundary surface approximately at right angles, differs but little whether it encounters that surface from the high velocity or the low velocity side.

NATURE OF METHOD USED

The underlying principle involved in the reflection method is, of course, the precise measurement, to the nearest one thousandth of a second, of the time required for the passage and return of an elastic wave or miniature earthquake, produced by detonating a charge of dynamite, from a reflecting surface in the crust. Knowing the velocity of the wave in different media, the distance or depth to that surface can be calculated. In soft formations the charges are usually fired in holes about 40 feet deep, since at less depth a large part of the energy is dissipated into the uppermost layer and into the air, causing surface waves and atmospheric sound waves which unduly disturb the instruments. Overthrust plates are commonly so hard, however, that surface waves are not produced. Moreover, 40-foot holes can not easily be drilled into them, and in the experiments herein described the dynamite was fired in holes not exceeding a few feet in depth. The distance between the shotpoint and the instruments and the amount of dynamite must be such that neither the direct waves through the uppermost layer nor the sound wave interfere with the recording of the reflected waves. Usually the distance was so chosen that the reflected waves arrived either in the interval between the arrival of the direct waves and the sound wave, or shortly after the sound wave.

BEARTOOTH OVERTHRUST

The first attempt to measure the thickness of an overthrust plate was made in July, 1934, on the Beartooth Plateau in northwestern Wyoming and south-central Montana, roughly 12 to 20 miles southwest of Red Lodge, Montana, along the new Red Lodge-Yellowstone Park highway. The experiment was carried out as part of the Yellowstone-Beartooth-Bighorn project initiated by Dr. W. T. Thom, of Princeton University. The funds which made the test possible were made available by the Geological Society of America. Only one day was available for the experiment.

The Beartooth overthrust plate consists of old crystalline rocks, granitoid in character at the localities occupied and locally somewhat gneissic. Flattish-topped, the Beartooth Plateau descends rather suddenly on its eastern side to the trace of the bounding overthrust fault which separates the overthrust plate from the over-ridden block. The surface parts of the latter are composed of Paleozoic and younger sedimentary formations.

Charges were fired and records made at three localities, at each of which different shotpoints, charges and distances between shotpoint and instruments were utilized.

The very first seismogram recorded not only a very definite reflection from the overthrust fault surface but also reflections from underlying strata. Using a velocity of 5.5 km/sec, calculated from the direct waves between shotpoint and instruments (maximum distance 337 meters) the thickness of the overthrust plate was found to be about 3,300 meters (10,800 feet). Similarly at the second point the thickness was determined to be about 2,500 meters (8,200 feet), and at the third point the depth below the surface was about 2,100 meters (6,900 feet). The data appear to agree very well with such geologic facts regarding the fault as can be observed at the trace.

FRAZIER MOUNTAIN OVERTHRUST

A second test of the seismic reflection method for determining the thickness of overthrust plates was made on Frazier Mountain during three days of field work in November, 1934. The mountain rises immediately west of Tejon Pass, where the Sierra Nevada joins the Coast Ranges of California, about 90 miles northwest of Los Angeles. Its east-west length is about 8 miles, its north-south width about 4 miles, and the elevation of its broad flat top is between 7,000 and 8,000 feet. The upper parts of the side slopes are precipitous.

The geological mapping of the Tejon Pass region by field parties from the California Institute of Technology had previously revealed that the structure of the mountain is most unique The entire upper part consists of old crystalline intrusive and metamorphic rocks These extend down the north slope to the San Andreas fault at the foot of the mountain But for more than three quarters of its periphery Tertiary beds form the lower slopes, and the contact line between the Tertiaries and the crystalline complex roughly parallels the contour lines In one excellent exposure the contact is horizontal These and other evidences led to the interpretation that Frazier Mountain is an overthrust slab of old crystallines on Tertiaries—a mountain without roots It seemed desirable to ascertain if possible the thickness of the slab at a few points by seismic methods Here, again, are rocks of high wave velocity lying on others of low velocity

Four instruments stations were occupied, of which the first was used primarily to determine optimum distances between shotpoint and instruments and the proper dynamite charges The other three stations were on a north-south line, one near the south edge of the mountain top, another near the north edge and the third in an approximately median position

After some experimenting at each point the travel times of the reflected waves were found to be 0 265 second at the southern point, 0 24 second at the middle point and 0 34 second at the northern point The velocities in the uppermost layer and its thickness differed considerably at the three localities, but the value of 4 1 km/sec, derived from the longest refraction profile (1,087 meters) shot at the northern point to secure velocity data, was used at all three points for all but the uppermost layer to which the lower local velocities were applied On the basis of the above data the thickness of the overthrust plate was calculated to be about 370 meters (1,200 feet) at the southern point, about 430 meters (1,400 feet) at the middle locality and about 580 meters (1,900 feet) at the northern point, with a possible error of a very few hundred feet caused by inadequate velocity data Subtracting these thicknesses from the surface elevations, about 7 700 feet at all three points, the corresponding fault surface elevations are 6,500, 6,300 and 5,800 feet The distance between the north and south points is about 8,800 feet and the average north south component of the dip of the fault surface is therefore about 5° toward the north The data also indicate that the average dip steepens toward the north The seismic results agree as well as could be expected with our geological knowledge derived from study of the periphery of the mountain

CONCLUSIONS

The investigations clearly demonstrate that it is possible to measure the thickness of overthrust plates by use of the seismic reflection method, and from a number of such measurements to determine the form of the fault surface

Since the method depends upon difference in the elastic constants of the rocks above and below the fault surface, it is applicable not only to those cases in which soft young low velocity strata overlie or underlie bodies of old crystalline high velocity rocks but also to those cases in which old crystalline rocks occur both above and beneath the fault surface, provided the velocities above and below differ materially Since velocities in different intrusives and metamorphics do vary considerably, and since quite different crystalline rocks are brought together along overthrust surfaces due to the great displacements, there is good probability that in favorable cases the surfaces can be followed back from the fault trace to much greater distances than the rear margin of the overridden soft sediments

The method can not be used successfully on those parts of overthrust surfaces which separate rock bodies in which elastic wave velocities are nearly equal, because the fault itself does not reflect the waves Also, since the thickness of fault gouge and breccia is usually considerably less than a wave length, these materials can not be expected to serve as effective reflectors

However, the maximum distance back from the fault trace to which reflections can be secured gives a minimum extent for the fault surface It is quite possible that if reflections can be recorded again at localities more distant from the trace than intervening futile points the fault surface can once more be identified and perhaps corroborated by backward projection of the dip determined from the points nearer the fault trace and forward projection of the dip derived from the more distant points

The experiments indicate that the amount of dynamite needed per charge in the old crystalline rocks is generally very small The best results were secured with charges ranging from a fraction of a pound to a very few pounds These quantities contrast with the 20 to 40 pounds per charge required in our recording of reflections from depths approaching 45,000 feet in the soft Tertiary and presumably older sediments of the Los Angeles basin In shooting on old crystalline rocks deep holes are not needed For most effective operation a crew of about seven men is desirable

JOHN P BUWALDA
BENO GUTENBERG

DISTRIBUTION OF MITOCHONDRIA IN THE FORAMINIFERAN, IRIDIA DIAPHANA

It has been occasionally noted[1] [2] that the mito chondria in a cell are arranged in greatest numbers at the locus of interchange of metabolites between the cell and its environment A review of the morphology of glandular cells[3] reveals that mitochondria are most numerous in the basal regions of such cells and that it is in these regions that metabolites are absorbed Doyle has carried this a step further to suggest that in *Amoeba* the mitochondria function as transportive elements within the cell

The structure of *Iridia diaphana* is significant in this regard The organism is abundant on *Posidonia* (turtle grass) at Dry Tortugas, Fla It is an arena ceous form which is particularly adapted to cyto logical research because it frequently leaves its shell and crawls about naked

The cytoplasm contains a large nucleus, numerous golden or reddish oil droplets 2 to 5 micra in diam eter, many colorless carbohydrate spheres 3 to 6 micra in diameter, numerous minute calcium oxalate crystals not over ½ micra long, and ovoid mitochondria which average ¾ micra in length The crystals and the mitochondria are the only structures which might be confused with each other because of their size and appearance They are readily differentiated in the living condition by means of polarized light The crystals are brilliantly optically active, whereas the mitochondria are not noticeably so

In the central protoplasmic mass, from which myriads of anastomosing filamentous pseudopodia ex tend, there are many currents of streaming protoplasm constantly in action These currents frequently lead to the bases of pseudopodia at which points only the mitochondria flow out into the hyaline cytoplasm The mechanism whereby the constituents are segre gated so that only the mitochondria leave the central mass when there are other equally small bodies present which never do is entirely unknown The mitochon dria, which are frequently larger in cross section than the cross section of the pseudopod, flow out into the pseudopodia and in so doing meet and pass other mitochondria which are returning to again mingle with the other cytoplasmic constituents of the central mass

Whatever the rôle of the pseudopodia, whether elimination of waste products, absorption of food or as contractile elements, they are always liberally sup plied with mitochondria, and mitochondria are the only formed bodies in them Conversely, whatever the rôle of the mitochondria, their presence in the pseudopodia gives them ample opportunity for the interchange of substances with the surrounding medium

Wm L Doyle

The Johns Hopkins University

[1] Horning, *Austral Jour Exp Biol and Med*, 2–5, 1925–28

[2] Doyle, Dissertation, The Johns Hopkins University In press

[3] Bowen, *Quart Rev Biol*, 4 1929

DIRECT ISOLATION OF PASTEURELLA-LIKE MICROORGANISMS FROM BRAINS OF HORSES SUFFERING FROM SO-CALLED CORNSTALK DISEASE

In a recent note in Science[1] mention was made of the isolation of pasteurella like microorganisms from the brains of seven horses that succumbed to so called cornstalk disease in different counties in Illinois These isolations were made following death of guinea pigs, pigeons and rabbits inoculated subcutaneously with horse brain tissue suspended in sterile physio logical sodium chloride solution, as well as saline sus pensions of mixed aerobic cultures from brains of naturally infected horses For the reason that labo ratory animals may harbor pasteurella and, following death from a variety of causes yield positive cultures, the brains of horses dying from so called cornstalk disease were cultured on different media to appraise the part laboratory animals might play in the positive pasteurella isolations following inoculation with horse brain tissue and mixed cultures from horse brain sus pended in saline

Each horse supplying brain tissue included in direct cultural studies, as in aforementioned studies, dis played a spontaneous encephalitic syndrome The affected horses originated on different farms over a territory extending from north central Illinois south more than 150 miles to the south central district of the state, including Will, Iroquois, Champaign, Chris tian, De Witt Douglas and Montgomery counties The horse brains were delivered to the laboratory in from one to six hours following humane destruction or death from so called cornstalk disease Immedi ately on arrival the encephalon was removed from the cranium and the meninges dissected from the brains Small pieces of the brain tissue were seeded in tubes of pork and beef meat mash broth The inoculated tubes were allowed to incubate for three to six days at 37° C Gentian violet agar plates were then streaked from the meat mash cultures with a platinum loop Colonies resembling pasteurella developing along the line of inoculation were picked on 10 per cent horse blood agar slants for identification

From eight different horse brains pasteurella like microorganisms were isolated by direct cultural meth- ods Similarly streaked cultures of the meat mash horse brain cultures on plain and blood agar plates were invariably overgrown with a variety of uniden-

[1] Science, 81 2093, 153, February 8, 1935

tified bacteria, including gram positive rods, *E coli*, streptococci and diplococci, as well as actinomyces, aspergilli and other unidentified molds

Robert Graham
University of Illinois

ERGOTOCIN

It has been found by the authors, working in con junction with Drs Davis, Adair and Rogers, of the Department of Obstetrics and Gynecology of the University of Chicago, that the alkaloids ergotoxine, ergo tamine, sensibamine are uniformly ineffective when administered orally to human mothers in doses of 2 mg Larger doses (2–4 mg) often induce unpleasant side reactions such as nausea, vomiting increase in blood pressure, diarrhea, etc However, even these large and dangerous doses do not induce contractions in the eighth day postpartum uterus, in all mothers While the number of cases studied by us is relatively small (15 cases) these large doses of the alkaloids were found effective only in about 30 per cent of the cases

We have found, however, that some fluid extracts of ergot, prepared in accordance with U S P method, were effective in doses corresponding to 3–4 gm of ergot The activity of these extracts could of course not be due to the known alkaloids (the amounts of these alkaloids as assayed by us were too small to account for the activity), and we undertook the prob lem of the isolation of the principle responsible for the efficacy of oral ergot dosage While preparations containing from 60 to 80 per cent of this principle were obtained by us over a year and one half ago, the isolation of the pure crystalline substance was made only on December 12, 1934 We have called this principle ergotocin In human mothers this substance is uniformly effective when administered orally in doses of 0 3 mg and intravenously in doses as low as 0 1 mg The yield of 0 3 mg of ergotocin is roughly equal to from 3 to 4 gms of crude defatted ergot This principle thus accounts for the activity of the fluid extracts

Ergotocin has now been used on over 150 patients and no unpleasant symptoms have been observed with it It controls uterine hemorrhage instantly Intra venously the effect is noticed within 15 seconds after administration In the first stages the action of ergotocin resembles that of pituitary extracts, except that its effect lasts for 3 or 4 hours, in marked con trast to the transient effect usually obtained with pituitary extract In its low toxicity, small dosage, prompt action in uterine hemorrhage, prolonged effect on the uterine muscles, ergotocin is unique among oxytocic principles

Ergotocin salts, as well as the free base, are white, well defined crystalline substances The base melts with decomposition at 155° The picrate, which is red, melts at from 195 to 197°, with decomposition The free base is somewhat soluble in water, and the salts are readily soluble One may obtain even a 10 per cent aqueous solution of some salts of ergotocin, a unique property among the alkaloids isolated from ergot Ergotocin differs from the known ergot alka loids (ergotoxine, ergotamine, sensibamine) in that it is not precipitated by Meyers's reagent in dilutions greater than 1 part in 7,500, while the other alkaloids are precipitated in dilutions of 1 200,000 to 1 2,000,-000 The optical rotation of the salts of ergotocin so far investigated is positive The chemistry of ergot-ocin as well as some of the attempts to synthesize it will be reported as soon as the work now under way is complete

We believe that with the isolation of this principle ergot therapy can now be put on a rational basis If one bears in mind that many ergots do not contain this principle (and yet are acceptable on the basis of the U S P assays), the cause of the difference of opinion among obstetricians regarding the value of ergot in obstetrics becomes evident

The authors wish to take this opportunity to thank most sincerely the Research Corporation, Inc, for a grant which made this work possible and the Eli Lilly Company for generously aiding us in this investiga-tion

Needless to say, without the cooperation and con stant guidance of Drs Davis, Adair and Rogers, on the clinical and pharmacological evaluation of this principle, this work would not have been brought to a successful conclusion

M S Kharasch
R R Legault
George Herbert Jones Chemical Laboratory
The University of Chicago

BOOKS RECEIVED

Brown William H *The Plant Kingdom* Pp ix + 869 1040 figures Ginn $3 50

Gerlach Walther and Werner Gerlach *Clinical and Pathological Applications of Spectrum Analysis.* Translated from the German by Joyce H Twyman. Pp 145 52 figures Hilger, London 15s.

Heisenberg Werner *Wandlungen in den Grundlagen der Naturwissenschaft* Nobel Prize Lecture Pp 45 S Hirzel, Leipzig

Klatzkin, Jakob *Der Erkenntnistrieb als Lebens und Todesprinzip* Pp 330 Rascher, Leipzig

Loria Gino *Metodi Matematici* Pp xv + 276 51 figures Ulrico Hoepli, Milan

Tams, W H T *Insects of Samoa* Part III *Lepidoptera* Fasc 4 *Heterocera* Pp 169–290 12 figures 13 plates British Museum, London 10s

SCIENCE

VOL 81 FRIDAY, APRIL 26, 1935 No 2104

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal

Lancaster, Pa Garrison, N Y

Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

ADDRESS OF THE PRESIDENT OF THE INTERNATIONAL GEOGRAPHICAL CONGRESS[1]

By Dr ISAIAH BOWMAN

AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK

Mr President of the Republic, Mr Minister of Culture and Public Instruction, Officers of Embassy, Ladies and Gentlemen

OUR first duty is to those members of the congress whose decease we record with profound regret The roll includes our able and warm-hearted president at the Cambridge Congress of 1928, General Vacchelli, a vice-president of the union, whose loss is deeply felt by all, but especially by his close associates in the executive committee of the union, and Miss Marion Newbigin, devoted and able editor of *The Scottish Geographical Magazine*

The congress will also wish to pay its tribute to the late William Morris Davis, in earlier years an active participant and leader in international geographical excursions and congresses whose professional interests and friendships recognized no national bounds

In opening the sessions of the fourteenth International Geographical Congress, I wish first of all to thank our hosts for the invitation they so hospitably extended six years ago at Cambridge and which was renewed at the Congress of Paris in 1931 I should like to comment also upon the excellence of the arrangements that have been provided and that reflect both devotion and intelligent care on the part of Professor Romer, Professor Pawlowski and their associates upon the Polish National Committee May we through them thank the Government of Poland for the interest which has been shown and for the gener-

[1] Opening address before the International Geographical Congress, Warsaw, 1934

ous support given to the plans of the congress and for the presence here to day of the head of the repub lic, President Moscicki? Under such favorable con ditions we are assured at the start of a useful interchange of ideas and a substantial strengthening of the bonds of friendship

It is fitting that I should here record with deep gratitude my dependence, and indeed the dependence of all of us in the Union, upon the unceasing devotion of the secretary general, Professor de Martonne During the past three years, his task has been both continuous and arduous, dealing with members distributed over the planet, with active commissions that have continuing programs, and with a president on the opposite side of the Atlantic His patience and resourcefulness have been equal to every task You will wish, I am sure, to join in thanking him for his generous contributions to our professional welfare

Since the last congress, three additional political units have adhered to the International Geographical Union Germany, Canada and Danzig It is with great pleasure that we welcome their representatives to day and look forward to their participation in both management and program

With all our diversity of interest and endeavor in the wide field of geography, we have a common dependence upon the map It is the symbol of our pro fession At one time or another, every geographer seeks to make a contribution to the map of the world —to survey still unmeasured portions of land and sea, to compile surveys into useful base maps, to display and interpret distributional phenomena, to deepen the understanding of the spatial elements of our physical world and its life relationships by invoking the highest standards of graphic art At the preceding con gress it was recommended that the cartographical institutes of the world should send representative material to an exhibition, now admirably installed, and which you will wish to visit repeatedly during the ensuing week It is the most representative map collection that has ever been displayed in the history of geographical congresses, 40 organizations from 23 countries participating in its development It is an especial pleasure to say this in Poland and in the presence of Professor Romer whose contributions to cartography have played so important a part in the development of geographical science We shall all hope that a catalogue and description of the maps in this inspiring collection will be one of the future publications of the union, so that those members not present and all geographers everywhere will be able to share with us the benefits we here derive from the maps on display

The various items of the cartographic exhibit re veal the many sided character of geography and so too do the topics before the congress under the six main headings of the program and the eight commission assignments upon which work has progressed during the past three years Notably important were the papers in physical geography that have always had a prominent place in the programs of the past This year we find both climate and physiography represented as well as cartography, human geography, historical geography, regional geography and educational geography Excursions to well selected places have afforded and will afford convenient access to some of the most interesting geographical features of Poland

With these opportunities before us, may I make a few observations about certain aspects of geography that may be thought appropriate in this international gathering Like every other science, geography attempts to widen the boundaries of knowledge At the same time it seeks to perfect techniques of research in order that its analyses may give us a deeper and, at the same time, a more vivid understanding of the complexities of life upon a diversified earth We attempt through these twin processes of discovery and method "to get discipline as well as information out of it," as the late William Morris Davis once phrased it With fuller equipment for deepening the under standing we are in the position of the astronomer who by perfecting and enlarging his telescope deepens his vision of the universe

Set in an inescapable, if somewhat modifiable environment, we seek to gain insight into the problems of other peoples, who, like ourselves, are trying to avoid the necessity of living in the hardest way or in the hardest places Adaptation is one of the key principles of geography as well as biology No part of the earth has had all its human possibilities revealed, its ultimate contribution to human welfare made fully known The search for new resources and new adaptations is still in progress We can not suppose that in 1934 we have reached the end of the road and have appraised all earth's possibilities Land and sea must be constantly resurveyed from new points of view Nor is it the earth alone that needs scientific exploration and systematic study. Economic and social mankind is on the march, evolving, adapting, inquiring about its own possibilities as well as those of the earth to which it is tied Man has sensed his powers, not fully developed them As destiny guider he is still an amateur

On a grand scale our geographical congresses en able us to widen the range of our experience, exchange knowledge for mutual benefit, quicken choice and action with respect to our neighbor, and, through association of effort, advance our study of realities so that eventually our minds may sweep through the whole interrelated earth with all its regional divers-

ties and attempt to understand the bases of life of all who share the planet with us. Until expert knowledge of existing realities is available we shall not find those sought for understandings of the world's peoples that are required to ease existing tensions. A rational change in relationships will not come by capricious action or through ignorance or provincialism. If we really understand how and why humanity is compartmented in its several regions, we shall find adjustments less difficult to make, even though we are at times oppressed by the complexities. The earth is a vast reservoir out of which man dips power. There is unequal access to that reservoir: the earth's benefits are unevenly distributed and, in addition, as Professor Penck has phrased it, "There is no land of unlimited resources." This is due in part to what we call the geographical layout. In part also it is due to the voltage of man's own mind, ever changing the significance of a given environment, searching out new advantages, developing new technical skills, seeking balance or proportion in community, regional and national life, extending the boundaries of knowledge, and adapting the earth and humanity to satisfy material and esthetic needs. To take an example from a single field: not always are desirable mineral deposits accessible—witness the geographical disposition of the coal beds of China, nor are they always required at the moment—witness the vast iron ore deposits of Brazil. We have begun, but in no sense finished, our regional inventories of fact about the resources of the earth, the uses which we may make of them, the mutual adaptations. Nor has any one yet been able to draw a clear line of distinction between matters under domestic control and those which can never be used rationally and fairly except through international consultation and agreement.

In Professor Romer's notable address at the opening session of the International Geographical Congress at Paris in 1931 is this striking challenge: "Would that this notable assemblage were evidence that geography is officially recognized in public life and national questions as an important subject." In the three years that have elapsed since this statement was made the world has passed through a period of strain that has suffered directly or indirectly every community wherever situated. In the face of local as well as world wide tension, intelligent men in every country have given much more thought than formerly to some of the fundamental bases of life. Whether or not we deplore the policy of national isolation and self containment, each country has felt it necessary to examine in detail its resources of every kind. In this examination geography has played a notable part. Were I to name those who have contributed to the discussion of material resources, and how to improve our use of them, I should be required to mention most of the professional geographers of the world.

That we have met in such number, under such favorable auspices, for the discussion of a wide range of both theoretical and practical questions is evidence of a great community of interest with respect to the earth and man's relation to it. Forty three nations are represented in this assemblage. There is promise of good attendance upon all the sectional meetings and helpful discussion. I venture to say that through the interchange of thought that takes place here we shall be better able to return to our several countries and do our part in community life as well as in research and education by more intelligent assisting the never ending process of adaptation of means to end in our use of earth's gifts.

SHELTERBELTS—FUTILE DREAM OR WORKABLE PLAN

By RAPHAEL ZON
DIRECTOR, LAKE STATES FOREST EXPERIMENT STATION

THE President's vision of a belt of forest trees, stretching through the Great Plains from North Dakota to Texas, caught the popular imagination as no other forest enterprise in recent years. The idea, suggested at the time when the Middle West had been suffering for several years from severe droughts and dust storms, was dramatized by popular imagination and newspaper publicity into a grandiose plan of changing the climate of the entire plains region, and eliminating droughts and dust storms through the planting of trees.

The plan, as popularly visualized, called for regimenting the trees into uninterrupted and undeviating parallel forest strips, 8 to 10 rods wide, rigidly spaced one mile apart, irrespective of topography, soil or direction of prevailing winds. This naturally brought forth some skepticism and occasionally outright condemnation of the plan. As a matter of fact, the Shelterbelt project, stripped of the exaggerations of its friends and the misinterpretations of its opponents, resolves itself simply into concentrated forest planting within a comparatively narrow belt some 100 miles wide and 1,200 miles long, in that portion of the Great Plains where climatic and soil conditions make

tree growth possible and where such plantations can benefit existing agriculture

As a result of intensive exploration by the Forest Service of the climate, soils, natural vegetation, existing shelterbelt plantings and agricultural conditions of the region, the boundaries of the 100 mile belt where tree growth is possible and desirable have been delimited As shown on the map, the center of the Shelterbelt roughly follows the 99th meridian, touching Devils Lake in North Dakota, Mitchell in South Dakota, Lexington in Nebraska, Kinsley in Kansas and Mangum in Oklahoma The western boundary of the belt coincides closely with a line of average annual rainfall of 15 inches in the north and 22 inches at the southern end of the zone Higher rainfall is needed farther south to compensate for the greater evaporating power of the air

West of this line, extensive planting of shelterbelts is considered hazardous, because of the low rainfall, difficulty of establishment, short life, poor survival and adverse soil conditions West of the proposed boundary is a region which has a relatively large proportion of submarginal land Such land should best be converted to grass and a simpler form of use, such as grazing The reestablishment of grass in this submarginal land is admitted to accomplish one of the purposes which shelterbelts are designed to accomplish in the farming region—soil protection There would be little for the trees to protect in that area, and the trees themselves would develop little more than as bushy growths, except in depressions where their effects as windbreaks would be negligible

The western boundary, however, does not mean that forest planting in all cases can not be successful farther to the west There are shelterbelts growing well in some places in eastern Colorado, Montana and Wyoming Nor does it mean that forest planting can be attempted on all soils within the belt itself The boundaries merely delimit an area within which forest planting offers the *best* possibility of success when soils, rainfall, type of farming and urgent need for shelterbelts are considered

The main purpose of planting shelterbelts is to provide protection to farmsteads, agricultural crops and cattle against the hot desiccating winds of summer and the cold blizzards of winter The greatest benefit of shelterbelt planting may be expected when it is superimposed on an already existing agricultural economy as is found within the proposed belt This, on the whole, is a region of fertile prairie soils which, with normal rainfall, is an important part of the granary of the United States Shelterbelts should help to stabilize this agriculture and leave it less at the mercy of the elements

East of the proposed shelterbelt, conditions for tree growth are more favorable, agriculture has been long established there, and many groves have already been planted by the farmers themselves This will undoubtedly continue to be the case However, the area designated for planting must be considered largely as an initial center of work, from which planting can spread both west and east of the boundaries when conditions warrant such an expansion

One of the questions generally asked is, "Can trees be made to grow in the Great Plains?" This region comprises, roughly, one third of the total continental area of the United States The precipitation over this region ranges from some 30 inches in the east to 14 inches in the foothills of the Rocky Mountains It is composed of a great variety of soils, ranging from sandhills to alkali and clay pan lands, and from true plains to rough broken topography It stands to reason therefore, that trees can not be successfully grown everywhere throughout the Great Plains region, but only in those portions of it where rainfall and soil conditions are not prohibitive

Even within the boundaries of the belt, the character of the soil may either preclude forest planting altogether or dictate variations in the manner of planting Within the belt there are roughly some 114,700 square miles of land This can be classified, according to soil and suitability for shelterbelt planting, as follows

- 66,400 square miles of fine textured soils—so called hard land ' Generally good agricultural land but not all suitable for forest planting Thus
  - 36 700 square miles—uplands, shelterbelt planting difficult
  - 24 900 square miles—principally in the eastern part of the belt, well suited to shelterbelt planting
  - 4 800 square miles—clay pan land and alkali basins, unfit for any tree growth
- 30,700 square miles—mostly sandy loams, good agricultural land, all favorable for shelterbelt planting
- 13,000 square miles of ' breaks ' or rough land Of this
  - 5,000 square miles—favorable for shelterbelt planting
  - 8,000 square miles—difficult to plant
- 4,600 square miles of sandhills well suited for forest planting in solid blocks

Of the total area, some 57 per cent lends itself to shelterbelt planting, about 39 per cent is difficult to plant, and 4 per cent is entirely unfit for planting It is evident, therefore, that there can be no continuous parallel forest strips, but each planting must be adapted to the soil conditions of every farm and

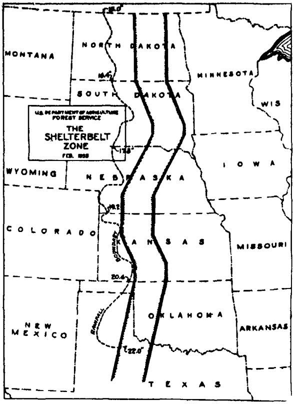

FIG 1

oriented to the damaging winds prevailing in each locality

The sandhills, which present the most favorable conditions from the standpoint of moisture and on many of which the ground water is within reach of trees, lend themselves best to planting in solid forest blocks A good illustration of such planting is found in the sandhills of Nebraska, where the Forest Service has planted successfully some 31 square miles About 410 square miles have recently been authorized for purchase in North Dakota for this type of planting

Planting in the "breaks" and gullies will be largely for the purpose of conserving water and checking soil erosion It will usually be confined to the slopes and active gullies and will follow narrow ravines On the "hard land," planting will be in the form of wind breaks around farmsteads and schools, or in the form of narrow strips of shelterbelts around fields

The best answer, however, to the question whether trees can be grown successfully in the prairie-plains region, is that trees *do* grow well in many parts of the region Shelterbelt planting in the Great Plains states is not a new undertaking It began with the earliest settlement in the region, when many pioneers brought trees with them in their covered wagons There has always been an instinctive desire on the part of the dwellers in the treeless prairie to create some protection, by means of windbreaks, for their homesteads Beginning with 1873, and in some states even earlier, the Federal Government sought to encourage tree planting by granting homesteads of 160 acres, on the condition that 10 acres be planted to trees Later, the Federal Government, through several bureaus in the Department of Agriculture, began to distribute planting stock to settlers for use in demonstration plantings, and has given advice on the selection of species, methods of planting and care of trees Likewise, most of the prairie and plains states have encouraged, through their State Forestry Departments, the establishment of shelterbelts by the farmers These plantations, in spite of rigorous conditions, have on the whole shown good growth and survival, and as a result of these combined efforts the landscape of the plains is now dotted by numerous planted groves of trees A survey last fall through the six plains states of North and South Dakota, Nebraska, Oklahoma, Kansas and Texas shows that to-day there is on an average one half acre of growing shelterbelt for every square mile surveyed, a larger proportion being in the three northern states With the large number of species now known to be suitable for dryland planting, and with better knowledge for maintaining the plantations, there is every reason to believe that future planting, conducted in the light of experimental evidence, should prove more successful than in the past

Another question often asked is, "What will be the benefits from shelterbelts?"

Whether shelterbelt planting, if carried out on a sufficiently large scale, will ultimately affect the climate over a wide territory is at present of purely academic interest, and proof of such an effect is not necessary to justify shelterbelt planting There is ample evidence, supported both by scientific records and every day experience, that shelterbelts have a local effect in reducing the wind velocity This mechanical retardation of wind movement is responsible for a whole series of effects It lessens evaporation from the soil immediately adjoining the shelterbelts, reduces the transpiration of crops growing under the protection of the trees, prevents blowing of the soil and keeps snow from being blown off the fields into gullies The aggregate effect is the more complete utilization of the precipitation Because crop failures often occur in the course of 24 to 48 hours of dry, blistering winds, the presence or absence of shelterbelts during this brief critical period may determine the fate of the crop

To make the shelterbelts most effective, it is essential that they be flanked with low shrubs or contain some undergrowth There are many native, drought-resistant shrubs, such as wild plum, caragana, Rus-

sian olive, sumac and choke cherry, which serve admirably this purpose, and at the same time have high value in furnishing food as well as protection for game, song and insectivorous birds. Alternation of forest strips with cultivated fields combines ideal conditions for the conservation and propagation of upland game birds, which may bring the farmer some cash return if properly handled.

Tree planting on slopes of gullies will reduce rapid surface run off and check soil erosion. As a means of conserving the moisture in the soil, shelterbelts, under certain conditions, may be as effective and less costly than the construction of dams on streams and dry gullies.

Above all, however, shelterbelt planting will make living conditions more comfortable and will add much needed variety to the monotonous prairie landscape. Probably the social benefits from windbreaks will be as great as the physical. If, by means of tree planting, agriculture may be made somewhat safer in a region subject to periodic droughts, if by breaking up the extremely large wheat fields, a diversified agriculture can be encouraged, if living conditions can be made more attractive by planting trees around farmsteads, then the still primitive and hazardous existence in the plains region will be raised for thousands of settlers to a higher level of permanence and stability. It will mean creating in the semi arid region a belt provided with the amenities of a higher cultural life.

Shelterbelt planting is only a part of a broader plan of water conservation and erosion control for the entire Great Plains region. The "black blizzards," for instance, may be mitigated but can not be stopped by shelterbelt planting within a narrow belt 100 miles in width. These dust storms originate farther west, where the original sod has been broken up by the plow. It is only by withdrawing certain areas of the western plains from crop production, returning them to grass and using them for controlled grazing, that the causes of dust storms may be largely removed.

To bring about the desired improvement in the physical and economic condition of the region, a coordination of effort by the various public agencies interested is essential. It will involve land retirement, controlled grazing, diversification of agriculture, water conservation by building ponds, shelterbelt planting, strip cropping, terracing, development of new varieties of cereals and soil binding grasses and a rationalization of land valuation and taxation.

SCIENTIFIC EVENTS

COOPERATION BETWEEN THE CHEMICAL SOCIETIES OF GREAT BRITAIN

THERE has recently been circulated to all members of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, according to *Nature*, a draft agreement in regard to cooperation. The adoption of the agreement is unanimously recommended by the council of the Society of Chemical Industry and the draft agreement was published in *Chemistry and Industry* on March 15. The agreement provides for the establishment of a fund to be administered by a Chemical Council consisting of three members nominated by the council of each society, together with three representatives of industry, coopted in the first instance on the nomination of the Association of British Chemical Manufacturers. The objects of the fund are the allocation of grants to the constituent bodies for the coordination of scientific publications, promotion of research, maintenance of a library, etc. Complete freedom of action is reserved to each constituent body in respect of the matter it publishes. The management of the library of the Chemical Society is delegated to a joint library committee, and contributions to the net annual maintenance expenditure are to be borne by the constituent bodies in proportion to their membership, with due allowance for overlap. This involves, for example, an increase in the contribution of the Institute of Chemistry to £654 and from the Society of Chemical Industry to £448. The agreement is for seven years and thereafter to continue for successive periods of three years, subject to right of withdrawal on giving one year's notice at the end of any period. If the agreement succeeds, it is anticipated that means of reducing subscriptions to the three organizations will be found.

CONFERENCE OF REPRESENTATIVES OF AGRICULTURE, INDUSTRY AND SCIENCE

DR. FRANCIS P. GARVAN, president of The Chemical Foundation, Inc., has announced that a joint conference of representatives of agriculture, industry and science will be held at Dearborn, Michigan, on May 7 and 8.

In addition to Dr. Garvan those joining in calling the conference are: Edward A. O'Neal, president of the American Farm Bureau Federation; Louis J. Tabor, master, the National Grange; Clifford V. Gregory, chairman, National Agricultural Conference.

The purpose of the conference is to survey the variety of farm products which through organic chemistry can be transformed into raw materials usable in industry, and to develop a plan for the joint cooperation of agriculture, industry and science for promoting

in orderly fashion an increasing use of American farm products in American industry

The hope is entertained that such cooperation will result in the gradual absorption of much of the domestic farm surplus by domestic industry, put idle acres to work profitably, increase the purchasing power of the American farmer on a stable, permanent basis, increase the demand for manufactured products which the American farmer wants needs and then will be able to purchase, create new work, thus reviving American industry and aiding American labor The sponsors of the conference believe that in proportion as these objectives are accomplished, the depression will recede and dependable national prosperity will return

The sessions will be held at Dearborn Inn, Dearborn, Mich, where Carl B Fritsche, chairman of the committee on arrangements, has opened headquarters Those who will take part in the program include Dr E R Weidlein, director of the Mellon Institute, Dr C F Kettering, president of the General Motors Research Corporation, and Dr Charles H Herty, Pulp and Paper Laboratory of the Industrial Committee of Savannah, Inc, at Savannah, Ga

THE WASHINGTON CONFERENCE ON THEORETICAL PHYSICS

Scientific men from various universities throughout the country gathered in Washington on April 19, 20 and 21 for a conference on theoretical physics under the joint auspices of the Carnegie Institution of Washington and the George Washington University

The conference was the first of a series to be held annually in Washington in connection with the researches in nuclear physics conducted by the Carnegie Institution, and the work which is being done in this field at the George Washington University under the leadership of Dr George Gamow Dr Gamow, who is known for his work on atomic nuclei and the theory of radio activity, has served during the past year as visiting professor of theoretical physics in the George Washington University His appointment to the regular staff of the university was recently announced

Day sessions of the conference were held at the university and evening sessions at the Department of Terrestrial Magnetism of the Carnegie Institution On the opening day members of the conference were the guests of Dr Cloyd H Marvin, president of the university, at a luncheon at the Cosmos Club

The purpose of the conference was to discuss informally problems and recent advances in nuclear physics Specific topics included (1) General nuclear model, (2) nuclear transformations, (3) the process of beta-disintegration, (4) the effects of high energy radiations Each session was opened by a brief introduction of the subject by one speaker, and the balance of the time left free for discussion

Those who attended the conference included Dr G Breit, University of Wisconsin, Dr Edward U Condon, Princeton University, Dr P A M Dirac, Dr S Goudsmit and Dr G E Uhlenbeck, University of Michigan, Dr A Lande, the Ohio State University, Dr L Nordheim, Purdue University, Dr H Bethe, Cornell University, Dr G Beck, University of Kansas, Dr J C Merriam, Dr John A Fleming, Dr L R Hafstad and Dr M A Tuve, of the Carnegie Institution of Washington, Dr L J Briggs, Dr F L Mohler and Dr L B Tuckerman, of the National Bureau of Standards, Dr Charles R Mann, Dr T B Brown, Dr James H Taylor and Dr George Gamow, of George Washington University Dr J R Oppenheimer, of the University of California and the California Institute of Technology, who was among those invited to participate, could not attend

Next year the conference will place the emphasis on certain problems related to chemistry

THE AMERICAN PHILOSOPHICAL SOCIETY

At the general meeting of the American Philosophical Society held in Philadelphia on April 18, 19 and 20, the Penrose Memorial Lecture was given by Dr W F G Swann, director of the Bartol Research Foundation of the Franklin Institute, whose subject was "Is the Universe Running Down?" The addresses at the annual dinner were given by Dr H H Donaldson, of the Wistar Institute of Anatomy, Dr Edwin G Conklin, of Princeton University, and Dr Harlow Shapley, director of the Harvard College Observatory On Saturday afternoon a reception was given at the Franklin Institute, preceded by an address entitled "A Brief Sketch of the Franklin Institute," by Dr Howard McClenahan, director of the institute In the morning there were addresses on "Cosmic Rays," by Dr Robert A Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology, and by Dr Arthur H Compton, professor of physics at the University of Chicago

The following members were elected

Dr Roger Adams, professor of organic chemistry and head of the department, University of Illinois

Dr Leo H Baekeland, honorary professor of chemical engineering, Columbia University

Dr Franz Boas, professor of anthropology, Columbia University

Dr Lyman J Briggs, director of the National Bureau of Standards

William L. Bryant, director of the Park Museum, Providence, Rhode Island

Rhys Carpenter, professor of classical archeology, Bryn Mawr College

Dr George Ellett Coghill, professor of comparative anatomy and member of the Wistar Institute of Anatomy, Philadelphia.

Dr James Bryant Conant, president of Harvard University

Dr Harvey N Davis president of Stevens Institute of Technology

Frederic Adrian Delano, Washington, D C

Dr Harold Willis Dodds, president of Princeton University

Dr Franklin Edgerton, Salisbury professor of Sanskrit and comparative philology, Yale University

Dr Frank Albert Fetter professor of political economy, Princeton University

Dr Dixon Ryan Fox president of Union College, Schenectady

Dr Yandell Henderson, professor of applied psychology, Yale University

Dr Karl Landsteiner, member of The Rockefeller Institute for Medical Research

Professor Charles Edward Merriam, chairman of the department of political science University of Chicago

Dr George Richards Minot, clinical professor of medicine at the Harvard Medical School and director of the Thorndike Memorial Laboratory

Dr Eugene Gladstone O Neill playwright, Sea Island, Georgia

Dr Frederick Leslie Ransome, professor of economic geology, California Institute of Technology

Dr Alfred Newton Richards professor of pharmacology, University of Pennsylvania

Dr F K Richtmyor, professor of physics and dean of the Graduate School, Cornell University

Dr Harold Clayton Urey professor of chemistry, Columbia University

Dr Hermann Weyl, professor of mathematics, Institute for Advanced Study, Princeton, N J

Dr William Hammond Wright, astronomer, Lick Observatory

Foreign resident

Dr Arthur Berriedale Keith, Regius professor of Sanskrit and comparative philology, University of Edinburgh

Dr Roland S Morris, of Philadelphia, was reelected president and Dr Henry H Donaldson, member of the Wistar Institute of Anatomy was elected a vice president Vice presidents reelected were Dr Edwin G Conklin, of Princeton University and Dr Robert A Millikan, of the California Institute of Technology Dr William E Lingelbach professor of modern and European history at the University of Pennsylvania, was elected secretary, and Professor John A Miller, of Swarthmore College, was reelected Dr Albert P Brubaker is curator Four councillors were elected to serve for three years These are Dr Frank Aydelotte, president of Swarthmore College, Dr Isaiah Bowman, director of the American Geographical Society and president-elect of the Johns Hopkins University, Gustavus W Cook, Dr Harlow Shapley, director of the Harvard College Observatory, and to fill an unexpired term of two years, Dr William Trelease, emeritus professor of botany, University of Illinois

RECENT DEATHS

DR. JOHN LIVINGSTON RUTGERS MORGAN, since 1905 professor of physical chemistry at Columbia University, died on April 12 He was sixty two years old

LIEUTENANT COLONEL FIELDING HUDSON GARRISON, U S A (retired) librarian of the Welch Medical Library at the Johns Hopkins University since 1930, died on April 18, at the age of sixty four years

JOSEPH EDWARD GUTHRIE, professor of zoology at the Iowa State College, died suddenly on April 16 He was sixty three years old

THE death is announced on April 20 at the age of forty seven years of Dr Jesse Erwin Day, professor of chemistry at the Ohio State University

DR RUDOLPH MELVILLE HUNTER died on March 19 He was a member of the American Institute of Electrical Engineers and of the American Association for the Advancement of Science He was also a foundation member of the Société Française des Electriciens, Paris A correspondent writes Mr Hunter was a widely known inventor and patent expert and counsel for many companies, among which were the General Electric Company, the Victor Talking Machine Company, the Westinghouse Company and the Dentists' Supply Company of New York

WILLIAM RICHARD HODGKINSON, who retired in 1918 after serving for thirty one years as professor of chemistry and metallurgy at the Military College of Science, Woolwich, England, died suddenly on April 8, in his eighty fourth year

Nature records the death of Dr Shepherd Dawson, principal lecturer in psychology, logic and ethics in Jordanhill Training College, Glasgow, known for his work on vision and statistical problems in psychology, on March 26, and on March 14 of Professor A Hantzsch, formerly professor of chemistry in the University of Leipzig

SCIENTIFIC NOTES AND NEWS

THE Franklin Medal and the sum of $1,000, representing the income from the Franklin Medal Fund of the Franklin Institute of Philadelphia, have been awarded to Dr Albert Einstein, of the Institute for Advanced Study at Princeton, and to Sir John Ambrose Fleming, consulting electrical engineer, En-

gland Dr Einstein is expected to deliver the principal address at the Medal Day exercises on May 15

PROFESSOR DOUGLAS JOHNSON, of Columbia University, has been awarded the Jovan Cvijic Medal of the Geographical Society of Belgrade, in recognition of his contributions to geography

THE Royal Geographical Society, London, has awarded Royal Medals as follows Founder's Medal, Major R A Bagnold, for his journeys in the Libyan Desert, Patron's Medal, W Rickmer Rickmers, for his long continued travels in the Caucasus and Russian Turkistan, culminating in his leadership of the Alai Pamir Russo German Expedition of 1928, the Victoria Medal has been awarded to E J Wayland for his work on the Quaternary geology of Uganda and the Rift, and its relation to man

THE Rivers Medal for 1934 of the Royal Anthropological Institute of Great Britain and Ireland was presented on April 9 to Miss Caton Thompson for her "field work in Egypt, the Libyan Desert, and Rhodesia, characterized by wide knowledge, sound judgment and insight" Before the presentation of the medal Miss Caton Thompson delivered the Rivers Lecture, which was entitled "A Revision of Recent Research upon Some Stone Age Problems in North Africa"

AT a special meeting of the National Academy of Sciences of Mexico, Dr Wallace W Atwood, president of Clark University, was elected to honorary membership in the society, and presented with a special gold medal Dr Atwood was in Mexico on behalf of the Pan American Institute of Geography and History, and which is planning to hold an international congress in Washington, D C, before the close of the year 1935

DR. GEORGE SARTON, editor of *Isis*, was elected unanimously a corresponding member of the Academia de la Historia of Madrid on March 29

DR. HOWARD T KARSNER, professor of pathology at the University of North Carolina, has been elected a member of the Society of Chemical Industry, London

DR. HOWARD T KARSNER, professor of pathology at Western Reserve University, has been elected to membership in the French Association for the Study of Cancer

THE honorary degree of doctor of science will be conferred by the University of Manchester on May 5 on Dr Alfred C Haddon, who before his retirement in 1909 was for many years lecturer in ethnology at the University of Cambridge

THE University of St Andrews will confer the doctorate of laws on Professor C H Browning, Gardiner professor of bacteriology at the University of Glasgow, on Professor A H Gibson, Beyer professor of engineering and director of the Whitworth Laboratories at the Victoria University of Manchester, and on Sir John Boyd Orr, director of the Rowett Institute, Aberdeen

DR JAMES BRYANT CONANT, president of Harvard University, was the guest of honor at the installation of a chapter of Sigma Xi at Wesleyan University on April 25 Professor George Howard Parker, of Harvard University, national president, and Professor Edward Ellery, of Union College national secretary, were the installing officers Delegates from Sigma Xi chapters of thirteen colleges attended the installation ceremonies

DR. JAMES B BULLITT professor of pathology at the University of North Carolina was recently elected president of the university chapter of the American Association of University Professors

G F WEBER, plant pathologist of the Florida Agricultural Experiment Station, has been elected president of the southern division of the American Phytopathological Association, and Dr O C Bryan, professor of agronomy at the University of Florida, has been elected presiding officer of the section of agronomy

DR JAMES FRANCK, formerly professor of physics at the University of Gottingen, has been appointed visiting lecturer in physics for the 1935 summer session at Cornell University where, during the six weeks period from July 8 to August 16, he will give courses dealing with atomic and molecular physics Professor Franck will also participate in the Symposium on Ionic Physics that will be held on July 4, 5 and 6 and which, with the cooperation of the summer session, is being arranged by the department of physics

PROFESSOR G E UHLENBECK, of Leiden, who, since 1927, has been at the University of Michigan, has been appointed professor of theoretical physics and mechanics at the University of Utrecht He succeeds Professor H A Kramers, who has been called to the University of Leiden Professor Uhlenbeck will enter upon his new work with an inaugural address to be delivered in October

EDWARD L MORELAND has been appointed to succeed Professor Dugald C Jackson, who will retire in June as head of the department of electrical engineering at the Massachusetts Institute of Technology

DR. JOHN A MCGEOCH, professor of psychology and chairman of the department at the University of Missouri, has been appointed professor of psychology at Wesleyan University The Wesleyan laboratory

will be enlarged and general research facilities will be increased

DR. CORNELIUS S HAGERTY, resident pathologist in the Presbyterian Hospital in Chicago, has been appointed assistant professor of bacteriology and pathology in the School of Medicine of the University of Alabama

DR BASIL CLARENDON MACLEAN superintendent of Touro Infirmary New Orleans has been appointed director of the Strong Memorial Hospital which is connected with the University of Rochester He succeeds Dr Nathaniel W Faxon who resigned in February to accept the post of director of the Massachusetts General Hospital

DR CARLETON R BALL, research associate in the Bureau of Public Administration of the University of California, has been named executive secretary of the Advisory Council for the Federal Government in the project to develop the economic and social resources of the Tennessee Valley The Advisory Council concerns itself with all phases of the Tennessee Valley development, which is a program of rural rehabilitation and power generation and distribution Apart from the Tennessee Valley authority, the administrative unit, the project is being participated in by a number of federal state and local agencies ranging from erosion control to wild life preservation

BRUCE A ROGERS of the Bureau of Standards, has become a member of the technical staff of the Battelle Memorial Institute, Columbus, Ohio where he will be senior metallurgist on a new program of research work relating to the automotive industry

A RECENT note in SCIENCE reported erroneously that Dr Joseph Tannenberg, of the University of Frankfurt, had been appointed for the period of one year director of the Bender Hygienic Laboratory at Albany, New York. Dr Tannenberg's official title is director of research Dr John J Clemmer, who went to Albany as associate director in 1933, is director of the laboratory, having succeeded Dr Arthur W Wright in May, 1934

DR PHILIP FOX, director of the Adler Planetarium, Chicago left on April 15 for the Griffith Observatory and Hall of Science at Los Angeles, where he will serve as guest director for the next two months Miss Maude Bennot assistant director of the Adler Planetarium, will be in charge during Dr Fox's absence Dr F R Moulton and Professor H S Everett, of the University of Chicago, will be lecturers for the period

THE Edgar Fahs Smith memorial lecture of the University of Pennsylvania will be delivered by Dr Colin G Fink, head of the division of electrochemistry of Columbia University, on May 23, at 8 15 P M The subject of the lecture will be "Electrochemistry's Debt to Edgar Fahs Smith"

THE eighth lecture of the Harvey Society will be given on May 16 at the New York Academy of Medicine by Dr John H Northrop, member of the Rockefeller Institute for Medical Research Princeton, N J, on The Isolation and Properties of Crystalline Pepsin and Trypsin'

PROFESSOR FRANCIS E LLOYD, of McGill University, gave a lecture on 'Carnivorous Plants" illustrated with motion pictures, before the department of botany of Columbia University on April 17

AT a stated meeting of the Franklin Institute on April 17 Dr W F G Swann director of the Bartol Research Laboratories gave a report on the work of the foundation

DR EDWIN B FROST, emeritus director of the Yerkes Observatory, gave addresses on April 9 and 10 at Berea College His subjects were Novae" and "Living in our Universe' Dr Robert A Millikan spoke on April 15 on 'The Social Significance of Science'

DR. PASTEUR VALLERY RADOT, a grandson of Pasteur, professeur agregé in the faculty of medicine at the University of Paris, lectured at the Johns Hopkins Hospital on April 25 on the 'The Links between Pasteur's Discoveries' and on Experimental and Human Anaphylaxis' on April 26

THE American Association of Physical Anthropologists is meeting on April 25, 26 and 27 at the Wistar Institute of Anatomy and Biology

A SUMMER meeting of the Botanical Society of America will be held at Minneapolis from June 24 to 28, 1935, in conjunction with the summer meeting of the American Association for the Advancement of Science The program is being arranged by a committee headed by Professor C O Rosendahl, chairman of the department of botany of the University of Minnesota The program will consist of invitation papers and a discussion on Tuesday morning, June 25 followed by a field trip in the afternoon and a dinner or smoker in the evening On Wednesday, June 26 an all day trip to the Bunker Prairie region will be followed by round table discussions in the evening For Thursday and Friday a two day trip to the Cloquet Duluth region by automobile is being arranged

THE New York Geographical Association held its first meeting at Syracuse University on April 13 Nine papers were presented during the morning, several of which dealt with land use A field trip studying

urban morphology occupied the afternoon, and in the evening there was a banquet followed by an address on "The Habitat of the Old Mayan Empire" by President Wallace W Atwood, of Clark University About fifty geographers were present from up state New York They organized informally by electing Dr George B Cressey, of Syracuse, as chairman and Miss Melvina Svec, of Buffalo, as secretary The next meeting will be held a year hence at Syracuse University

CIRCULARS recently sent out by the organizing committee, of which Professor Ignacio Bolivar is chairman, state that the sixth International Congress of Entomology is to be held from September 6 to 12 in Madrid The Spanish government has issued invitation to foreign countries with the hope that official delegates will be sent Entomologists who expect to attend and who have not received registration blanks should address Professor C Bolivar y Pieltain, Museo Nacional de Ciencias Naturales, Madrid 6, Spain It will be noted that the date of the twelfth International Congress of Zoology, which is to be held in Lisbon, Portugal, is so timed that it will permit attendance at both congresses

Nature announces that the twelfth International Congress of Zoology will be held at Lisbon from September 15 to 21 under the presidency of Professor A Ricardo Jorge, professor in the Faculty of Sciences in the University of Lisbon and director of the Zoological and Anthropological Department of the National Museum of Natural History Among social events proposed are receptions by the President of the Republic, by other ministers, by the rector of the university and by the municipality of Lisbon, and various excursions, including one to Madeira and the Azores to take place after the congress, are contemplated Zoologists desiring to take part in the congress are requested to communicate with the president, Professor Arthur Ricardo Jorge, director, Zoological and Anthropological Department, National Museum of Natural History, Lisbon, Portugal, from whom particulars can be obtained

THE eleventh annual meeting of the New York State Geological Association will be held in Utica, N Y, on May 10 and 11, under the leadership of the department of geology of Hamilton College The field trips will be mainly concerned with the geology of the Mohawk valley and adjacent areas The trip on Friday, May 10, has been planned to show the following features Ilion and Frankfort gorges, stratigraphy and glacial lake outlets, geomorphology of the Mohawk valley at Little Falls, Pre Cambrian rocks and Paleozoic stratigraphy in the vicinity of Little Falls, Inghams Mills and Dolgeville, structural geology of the areas around Little Falls, Dolgeville and Manheim On Saturday, May 11, the group will travel from Utica to Trenton Falls to study the stratigraphy of the Trenton together with the glacial and post glacial features of this section of the Mohawk valley The annual banquet of the association will be held at the Hotel Utica at 7 00 P M, on May 10 The field trips and meetings are open to any one interested in the geology of this section Additional information regarding the trips will be sent on request

FIRST reports of the Cornell American Museum Ornithological Expedition have been received from Dr A A Allen, of Cornell University, head of the expedition The first stop, at Thomasville, Georgia, resulted in the recording of limpkins and anhingas as well as wild turkeys and fish hawks of the vicinity In Florida headquarters were established at Winter Park and trips made into the Kissimee Prairie where sound and motion pictures of the now rare sandhill crane were secured, and also valuable material on Audubon's caracara, the wood ibis, the American egret, the bald eagle and many more common species Dr Allen and A R Brand made a trip to the Gulf Coast where they secured film of pelicans, cormorants and various species of gulls and shorebirds One of the main objectives of the expedition is to find the ivory billed woodpecker, which is now very near extinction

A SURVEY in Puerto Rico "for the purpose of developing and establishing measures for soil erosion" will be undertaken with an allotment of $42,000 for that purpose from the sugar processing tax funds from that area The survey, which is to be in charge of the Bureau of Chemistry and Soils of the United States Department of Agriculture, has been recommended by the Puerto Rico Policy Committee

APPROVAL of the purchase of 696,000 acres for national forest reservations has been announced by Secretary Dern as president of the National Forest Reservation Commission More than $2,998,000 is involved. In New England the buying of nearly 49,000 acres was approved Forty eight thousand four hundred and eighty six acres were acquired in Rutland, Windsor, Addison and Washington Counties, Vt, to be added to the Green Mountain National Forest, 198 acres will be added to the White Mountain Forest in New Hampshire More than 210,000 acres were bought for national forests in the Appalachian region in Pennsylvania, Virginia, West Virginia, the Carolinas, Kentucky and Tennessee The lands, on which options already have been taken, will be put immediately under Forest Service protection and management Part of the work will be done by CCC units.

DISCUSSION

ORDOVICIAN BLACK SHALES OF NEW YORK

THE Ordovician 'black' shales of the Mohawk valley, in New York, display a remarkable succession of fossil bearing zones in a monotonous lithologic sequence Before the stratigraphic arrangement of these had been worked out, the whole had been generally regarded as 'Utica "

The senior author has shown,[1] however, that while the true Utica in passing eastward changes into the "Frankfort' sandstone facies, the underlying Trenton limestones correspondingly change into similar black shales, distinguished by him as the Canajoharie shale [2] At the inception of this change, near its western end, the higher Canajoharie had earlier received the name Dolgeville passage beds" At east, the black shale facies passes over into a more sandy one, represented at first (in its upper part) by the Schenectady,[3] and across a fault zone wholly by the Snake Hill beds [4]

All these black" shales are characterized by graptolites, which straggle eastward into the sands and westward into the limestones, thus serving as diagnostic and guide fossils By their aid, eight faunal zones have been discriminated,[5] three within the true Utica, four in the Canajoharie and still another lower one in the Snake Hill

At the time, except for the Deer River or uppermost Utica, formational names were not proposed for these, as was done for the succeeding zones in the Lorraine sandy beds farther west and northwest Since, however, these zones have been established beyond question, and geographic names for them will be convenient, they will be designated as follows

Holland Patent for upper Utica or zone of Climacograptus pygmaeus

Loyal Creek for middle Utica or zone of Dicranograptus nicholsoni

Nowadaga for lower Utica or zone of Climacograptus typicalis

Fort Plain, for uppermost Canajoharie or zone of Climacograptus spinifer

Chuctenunda, for upper middle Canajoharie or zone of Lasiograptus eucharis

Gansevoort for middle Canajoharie or zone of Glossograptus quadrimucronatus cornutus

Sprakers, for lower middle Canajoharie or zone of Diplograptus amplexicaulis

Morphy, for lowest Canajoharie or zone of Mesograptus mohawkensis

Van Schaick, for lowest Snake Hill or zone of Climacograptus caudatus

RUDOLF RUEDEMANN
GEORGE H CHADWICK

NEW YORK STATE MUSEUM
ALBANY

[1] R Ruedemann, *New York State Museum Bulletins* 162 5–6, 29, 1912, 42 558–559, 1901 169 51–52, 1914, 258 24–26, 73, 1925, 285 29–33, 1930

[2] *Ibid*, 162 28 227 123, 1919

[3] *Ibid*, 162 38, 169 95, 227 123

[4] *Ibid*, 162 59 227 123

[5] *Ibid*, 227 116, 123–126, 130, 258 24–26, 52–53, 285: 5, 31

NATURE OF THE LIGHT RAYS ON THE SURFACE OF THE MOON

THE recent announcement by the Committee on Lunar Geology of the Carnegie Institution suggests a plausible explanation of the nature of the bright rays radiating from certain craters on the moon's face Some thirty of the moon's thirty thousand visible craters show this characteristic, led by Tycho, whose rays can be followed for more than a third of the moon's circumference

The committee reports that the moon seems to be covered with volcanic ash, a condition quite in keeping with the multitude of true volcanoes which may be detected

Volcanic ash is characterized by its division into irregular even ragged pieces with a wide range in size Under the waterless, airless condition of the moon and with the small value of lunar gravity it is to be expected that this material will form a cover possessing a high degree of randomness in the arrangement of its particles

If then the underlying solid were struck a sharp blow, producing a bell like vibration, the vibrations would serve to shake down and so orient the superficial particles in such a way that their light-reflecting properties would be changed

We are thus led to interpret the rays as a purely superficial indication of elastic vibrations in the solid substance of the moon, material we naturally infer is of the same general nature as terrestrial igneous rock This surface effect, depending only on the vibration of the underlying solid, would naturally run over mountains, through craters and across plains, as observed, and being an orientation of the surface particles rather than a depression of the parts, there would be no resulting shadows

The moon shows evidences of its history on its surface in a most impressive way and the larger craters may easily be classified as to age It is notable that those with rays are "young," with sharply defined edges and little evidence of more recent disturbance This is as we should expect, for whether we consider

the volcanic or the impact activity every movement of material covers existing landscape features including the rays, which, having little height, would be early obscured and so observable only in connection with the later craters Indeed, it is quite probable that the rays, which to us are such an important feature of the lunar face, would be quite undetectable to one on the moon itself

To secure such a ringing blow as is evidenced by Tycho would undoubtedly require a rare combination of high meteoric speed with favorable angle of impact

Interpreted thus, the rays form valuable corroborative evidence that a portion of the lunar craters are of meteoric origin

Regarding meteoric velocities, Olivier[1] has assembled a great amount of observational data, indicating that meteors enter our atmosphere with velocities ranging up to 80 Km per sec (50 miles per sec) a velocity capable of giving a truly sharp concussion if unchecked by a protecting atmosphere In this connection it should be recalled that the earth's dominating gravitational field would quite effectively screen our side of the moon from the impact of low velocity meteoric matter

George W Munro

Purdue University

HIGHWAY MORTALITY AMONG MAMMALS

In the course of an automobile trip taken recently (October 13 to 16, 1934) between Iowa City, Iowa, and Albany, New York, a distance of 1,063 miles, Mrs Stoner and I kept a record of the larger mammals lying dead on the thoroughfare All highways traversed were paved, and practically the entire distance was covered during the hours of daylight Our journey carried us successively through Davenport, Iowa, Ottawa and Joliet, Illinois, Valparaiso and Elkhart, Indiana, Ypsilanti and Detroit, Michigan, Windsor, Hamilton and St Catharines, Ontario, Canada, and Niagara Falls, Batavia, Auburn, Pompey and Cherry Valley, New York

It seemed apparent that all the mammals counted had been killed by passing automobiles Some of the bodies were badly crushed and evidently the animals had been dead for a few days However, most had met death but a short time before we passed A few were scarcely mutilated

While neither the number of individuals nor of species represented by our records is strikingly large, the mortality rate among a few species due to rapidly driven motor cars is comparatively high And when account is taken of the thousands of miles of excellent paved roads which extend throughout the United States and Canada, it becomes apparent that the total mammal mortality due to the constantly increasing number of high speed automobiles driven over constantly improved and extended super highways attains rather appalling proportions Particularly is this true among skunks and cottontail rabbits

The list of six identifiable species of mammalian casualties encountered on this trip in Table 1 also includes a number of individuals which, in passing, it was not possible to determine satisfactorily It is

1 "Meteors," Charles P Olivier, Williams and Wilkins Company, 1925

TABLE 1

Tabular Summary of Mammalian Casualties Encountered on the Highway Between Iowa City, Iowa and Albany, New York

State or province	Date	No of miles	Name of mammal							
			Common skunk	Domestic cat	Gray squirrel	Muskrat	Brown rat	Cottontail rabbit	Undetermined	Totals
Iowa	Oct 13	58	1					2	2	5
Illinois	Oct 13	183	2	3				4	3	12
Indiana	Oct 13 and 14	97	1	3		1	1	3		9
Michigan	Oct 14	165		6				1	2	9
Ontario	Oct 14 and 15	255	1	3	1			3	3	11
New York	Oct 15 and 16	305	9	3	1			4	3	20
Totals		1,063	14	18	2	1	1	17	13	66

altogether likely that at least some of the undetermined individuals upon closer examination, could have been assigned to certain of the forms definitely enumerated

Several points of special interest are associated with these findings

(1) The consistency of the destruction by motor traffic on our highways of two species of mammals, the cottontail rabbit (*Sylvilagus floridanus*) and the common skunk (*Mephitis mephitis*) is at once apparent Both species are more or less nocturnal in habits and evidently many individuals meet death while feeding or seeking food During the entire trip we saw neither a live cottontail nor a skunk

(2) So far as could be judged from highway mortality, the mammal population of Ontario is considerably less than that of any state through which we passed However, it should be noted in this connection that at this season of the year, automobile traffic in the province is scarcely as heavy as that in any of the states under consideration

(3) The average per mile mortality rate of mammals in the States varied from 054 individuals in Michigan to 091 in Indiana A total of 11 examples recorded on the 255 miles traveled in the Province of Ontario gives an average of only 043 individuals per mile

(4) While the domestic cat ranked highest in point of number of individuals recorded, with the cottontail and the skunk second and third, respectively, more dead skunks were noted on the 305 miles of New York road traveled than on the 758 in the other four states and the Province of Ontario combined The carcasses of the 9 New York skunks discovered give the comparatively high average of 029 individuals of this species per mile or 1 dead skunk for each 34 miles traveled in the Empire State Remains of at least one skunk were recorded for Ontario and for each of the states except Michigan The mortality figures suggest that this mammal is considerably more abundant in New York State than in any other here considered

(5) Further interest attaches to the present enumeration of mammalian motor car casualties on the highways when it is compared with the records obtained by the writer on two other extended automobile journeys The first (SCIENCE, 61, No 1568, 56–57, 1925) concerned a round trip from Iowa City, Iowa, to Lake Okoboji, Iowa, a distance of 632 miles, made in June and July 1924 On the highway, about 400 miles of which were graveled, while the remainder was simply graded earth, a total of 42 dead mammals representing 9 species, was recorded In this lot the thirteen lined spermophile headed the list with 18 casualties while the cottontail ranked second with 12 Only 1 skunk was noted

The second (SCIENCE, 69, No 1800, 670–671, 1929) concerned a trip from Iowa City, Iowa, to Sanford, Florida, a distance of 1,400 miles, made from October 1 to 11, 1928 The route "led through southeastern Iowa, central Illinois, southwestern Indiana, western Kentucky and Tennessee, central Georgia and north central Florida" On the highway, approximately 1,000 miles of which at that time were paved, we recorded 45 examples of dead mammals represented by 10 species The cottontail led the casualty list with 7 individuals Second in point of numbers was the domestic cat, with 6 individuals, while but a single dead skunk was observed

Of course so many variables are involved in a consideration of data of this sort that far reaching conclusions are scarcely warranted on the basis of the bare facts as here outlined Nevertheless, the observations seem worthy of comment and provide food for reflection and speculation for the student of distribution and ecology as well as for the conservationist

DAYTON STONER

NEW YORK STATE MUSEUM

THE PAINT CREEK METEORITE

THE department of geology of the College of Wooster recently received from Dr J H Todd, a physician of Wooster, Ohio, a splendid specimen of an iron nickel meteorite The donor, now ninety eight years of age, is the oldest practicing physician in Ohio, if not in the United States, and is the oldest member of the Ohio Academy of Science As a young man he became interested in geology and archeology and has, during his long life, given much attention to the collection of geological and archeological specimens, having donated no less than 35,000 Indian relics to the Ohio State Archeological Museum, 5,000 to the City Museum of Wooster, Ohio, and a large number of geological specimens to the College of Wooster

According to Dr Todd the meteorite fell, in 1868, in the vicinity of Paint Creek, on the property of William Johnson, located about three miles from Hopewell Church in Holmes County, Ohio Johnson, who lived on a terrace, a short distance back from Paint Creek, heard the noise of the approaching meteorite and ran to his porch Upon looking up, he saw the flaming body approaching with a trail of fire behind it As he watched it, it exploded almost directly over him, breaking into what appeared to him to be thousands of fragments The larger portion then started almost straight down, striking a fence about a quarter of a mile down stream, toward the mill It seared the fence for some distance and then buried itself in the ground Johnson dug the meteorite from a depth of about 4 feet, where it was resting on bed rock He told of the incident to Dr Todd at the time he gave the latter the meteorite

and his story was verified by two millers, Adam Hoffstadt and John Mooch, who operated a flour mill on Paint Creek not far from the scene and were present when the meteorite was extracted from the ground

The meteorite weighs 20½ pounds and is about 8 inches long and 7 inches wide The forward part is smooth and striated, coming to a broad, blunt point, the leeward portion is broad and rough and without grooves or striations It is pitted in places No sections of it have been made, but it is believed, from its external appearance, to have the same structure common to the iron nickel variety of meteorite There is no record of this meteorite in scientific literature and the unusual conditions associated with its fall make it of interest to science Few meteorites have been seen to fall at a definite location and then dug from the ground The depth to which it penetrated, through the mantle rock to the bed rock, 4 feet from the surface, indicates the force with which it struck the ground

KARL VER STEEG

COLLEGE OF WOOSTER

REPORTS

MILTON RESEARCH AWARDS AT HARVARD UNIVERSITY

THE grant of fifty six awards amounting to $61,815 to members of the faculty of Harvard University for use in research work during the academic year 1935–36, under the provision of funds established by the late William F Milton, '58, and Joseph H Clark, '57, has been announced Awards in the sciences are as follows

KENNETH T BAINBRIDGE, assistant professor of physics, to purchase apparatus for concentrating isotopes

THOMAS BARBOUR, *professor of zoology and director of* the University Museum, and ALFRED S ROMER, professor of zoology, to collect fossil reptiles in Southern Brazil

PAUL D BARTLETT, instructor in chemistry, to study quantitatively the so called "Positive Halogen" in organic compounds

HENRY E BENT, assistant professor of chemistry, to study the absorption spectra of organic free radicals at low temperatures

HENRY B BIGELOW, professor of zoology, for a continuation of the investigation of siphonophores collected by Dr Johannes Schmidt on the last *Dana* Expedition, 1928–30

MARLAND P BILLINGS, assistant professor of geology, to complete the geology of the New Hampshire portion of the Mt Cube Quadrangle and the Chocorua Quadrangle

NICHOLAI A BORODIN curator of fishes to study the anabiosis of fishes

FRANK M CARPENTER, assistant curator of invertebrate paleontology, to study fossil insects from Creede shales, Colorado

HUBERT L CLARK, associate professor of zoology, to illustrate report on Australian Echinoderms

FRANZO H CRAWFORD, assistant professor of physics, to continue the study of Schumann absorption of polyatomic molecules

WALTER F DEARBORN, professor of education, to organize records obtained over a twelve-year period of the mental and physical growth of American public school children

OLIVER L FASSIG, research associate, Blue Hill Observatory, to continue work on report on the climate of Puerto Rico

MERRITT L FERNALD, professor of natural history, to produce engravings of technical details of critical or newly studied plants and to map their geographic affinities

LOUIS F FIESER, associate professor of chemistry, to continue an investigation of organic cancer producing compounds

PAUL R GAST, assistant professor of forestry, to extend present program to a study of the effect of varied nutrition and radiation on the growth of seedling pines

JAMES C GREENWAY, JR., assistant curator of birds, to publish a report on a collection of birds from the Coastal Range between the Markham and Waria Rivers, northeastern New Guinea

EARNEST A HOOTON, professor of anthropology, to continue the study of human eye pigmentation by means of color photography

CORNELIUS S HURLBUT, JR, instructor in mineralogy, to study corundum deposits of western United States

BERNARD M JACOBSON, research fellow in medicine, to purify, to identify chemically and to study the biological activities of the materials in liver which are effective in pernicious anemia

GEORGE B KISTIAKOWSKY, associate professor of chemistry, to study the heat capacities of polyatomic gases by the adiabatic expansion method

ESPER S LARSEN, JR, professor of petrography to continue the study of minerals by x ray analysis

L DON LEET, instructor in geology, to compile a book detailing the principles of seismological investigations and reporting results of current research at Harvard

THEODORE LYMAN, director of Jefferson Physical Laboratory, to continue x ray studies

LIONEL S MARKS, professor of mechanical engineering, to investigate the flow of air through centrifugal fans with the hope of putting the design on a rational basis

HARRY R MIMNO, assistant professor of physics, to con

tissue studies on the measurement of the effective height of the Kennelly Heaviside layers

CHARLES PALACHE, professor of mineralogy, to continue work on revision of Dana's "System of Mineralogy"

HUGH M RAUP, research associate in the Arnold Arboretum, to continue the investigation of the systematic and geographic botany of the subarctic Mackenzie River basin in northwestern Canada

ALBERT SAUVEUR, professor of metallurgy and metallography, COMFORT A ADAMS, professor of engineering and JACOB P DEN HARTOG assistant professor of applied mechanics, for the study of metallurgical and stress problems of welding and stress relieving

DONALD SCOTT, director of the Peabody Museum, to permit the Peabody Museum to cooperate with the Division of Anthropology in an expedition to Kashmir and the Tibetan border

HARLOW SHAPLEY, director of the Harvard College Observatory, and DONALD H MENZEL, assistant professor of astronomy, for an expedition headed by Dr Donald H Menzel to observe the Siberian total eclipse June 19, 1936

JABEZ C STREET, instructor in physics to study the production of induced radioactivity by neutrons and the disintegration of atomic nuclei by protons and deutons

RICHARD P STRONG, professor of tropical medicine, to prepare illustrations for the monograph—"Onchocerciasis, with Special Reference to the Central American Form of the Disease"

YELLAPRAGADA SUBBAROW, Austin teaching fellow in biological chemistry, to isolate and investigate the structure of substances in liver which are active in pellagra and pernicious anemia, and which cause reticulocytosis in guinea pigs

MORGAN UPTON, assistant professor of general physiology, to study the integrative action of the central nervous system by means of experiments on the binaural localization of sound

WILLIAM F WELLS, instructor in sanitation, to study the effect of ventilation factors on the viability and dispersion of bacteria and other living elements in air

JOHN H WELSH JR., instructor in zoology, and FENNER A CHACE JR. assistant curator of marine invertebrates to study the eyes of deep water crustaceans

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE DEVICE FOR THE RAPID OBSERVATION OF OBJECTS IN LATERAL AND VENTRAL VIEWS

THE necessity of observing all surfaces of amphibian eggs with the least amount of manipulation has resulted in the development of several devices[1,2] The simple apparatus here described has the advantages of being inexpensive and of requiring only about 25 minutes to make or repair, it is not easily damaged In rapid succession one may obtain lateral or ventral views, or both simultaneously

A diagrammatic section through the device is shown

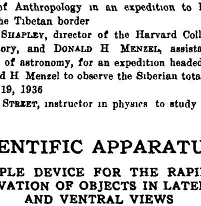

FIG 1

[1] J F Daniel and A B Burch, *Univ Calif Publ Zool*, 39 201, 1933

[2] A M Schechtman, *Univ Calif Publ Zool* 39 303, 1934

in Fig 1 It consists of a solid, rectangular block of paraffin (b), in one side of which is excavated a chamber just large enough to hold firmly the two juxtaposed 90° prisms (p^1 and p^2), which are cemented in place with a warm scalpel The upper face of one prism (p^1) forms the floor of a reservoir (r) into which is placed the object (e) to be observed The walls of this reservoir are composed of paraffin on three sides, the fourth being formed by the upper portion of the external prism (p^2) Ventral views (vv) or lateral views (lv) or both simultaneously may be obtained by simply altering the position of the device with reference to the microscopic objective (ob) The floor of the reservoir (r) may be made perfectly level by planing thin strips from the lower surface of the paraffin block

A M SCHECHTMAN

UNIVERSITY OF CALIFORNIA AT LOS ANGELES

A MICROTOME KNIFE HOLDER FOR SAFETY RAZOR BLADES [1]

CONSIDERABLE difficulty has been experienced in using the razor blade holders commercially obtainable The blade is not held sufficiently rigidly to permit of fine sectioning The razor blades available seem to have quite as good an edge as the ordinary microtome knife and are, of course, much less expensive Cham-

[1] From the laboratories of insect physiology and toxicology, Division of Entomology and Parasitology, University of California, Berkeley, Calif

berlain[2] discusses holders and implies that the commercial ones are not desirable

The obvious need is a method of clamping the blade rigidly and yet permitting easy adjustment of the amount of blade projecting It is also desirable that the angle which the bevel on the razor blade makes with the paraffin block is small so that a true cutting and not a scraping action is obtained In Fig 1 is

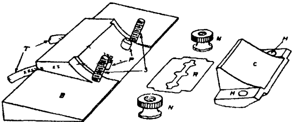

FIG 1

shown a blade holder which embodies these requirements[3] The razor blade, R, fits over the pins, P, which project from a milled cylindrical surface in block B The clamping block, C, is placed over the blade, the screws S, passing through the holes, H, and is held down by the nuts, N The bottom of the clamping block is a curved surface having a slightly greater radius of curvature than that in the block, B, to insure a tight clamping at the projecting edge The pins, P, are eccentrically mounted so that by turning them the amount of blade projecting may be varied from 0 25 to 1 25 mm The tubes, T, lead to a hole in the block lying just under the blade and are used for cooling the knife For cutting thin sections in paraffin, cooling the knife by running cold brine through it will give a much better ribbon and less compression of the sections The block is dimensioned to fit in the standard microtomes and is mounted so that the face toward the paraffin block is inclined 4°, which will give a clearance angle of about 8° to the cutting edge

This holder has been in use for over a year and has proven entirely satisfactory Using razor blades of several makes, it is possible to section whole insects, such as grasshoppers, butterfly pupae and insect eggs, when imbedded in paraffin It is also possible to make 5 µ sections of plant material, such as insect galls, when imbedded in paraffin

RODERICK CRAIG
CHARLES WILSON

INEXPENSIVE GREEN FILTERS

FILTERS which are quite satisfactory for the examination of tissues stained by the Feulgen method can be made by placing one or more thicknesses of green Cellophane between two large microscopic slides and binding the edges with lantern slide tape Filters of different densities are obtained by varying the number of layers of Cellophane used

ESTHER CARPENTER

SMITH COLLEGE

SPECIAL ARTICLES

HEREDITARY BRACHYDACTYLIA AND ASSOCIATED ABNORMALITIES IN THE RABBIT

DEFORMITIES of the hands and feet are among the oldest recognized hereditary variations in man They have been reported in apparently unrelated families scattered throughout the world, and appear in a variety of forms ranging from minor brachydactylia to complete absence of hands and feet

Investigations based on family histories have shown that these are dominant mutations, but the material available for study has been limited and not subject to experiment or control The mating of individuals showing different forms of abnormality has not been recorded, and the genetic relation of this group of variations is uncertain

Comparable variations have recently been encountered in the rabbit, and the occurrence of a series of deformities from brachydactylia to acheiropodia in a single line of animals indicates that in this instance they are expressions of a single primary mutation altered by modifying factors or of a closely linked group of genes The appearance of the mutation in a laboratory animal naturally adapted to experimental procedures offers an approach to the study of the genetic relations of these abnormalities, and additional interest is attached to these affections because of a closely associated functional inferiority The purpose of the present paper is to describe the variations as they occur in the rabbit and to report on the progress of genetic studies

The first deformity of this order was discovered in the offspring of a brother sister mating of apparently normal animals These animals were hybrids derived from the crossing of a pure-bred English doe with a male of mixed breed for the purpose of studying the inheritance of a peculiar eye color Both parental lines had been bred for generations, and there were instances in which matings had been made which should have disclosed the presence of the deformity in either line, but none occurred until the two lines were crossed as indicated above Subsequently, the

[2] C J Chamberlain, "Methods in Plant Histology," University of Chicago Press

[3] These holders may be obtained from J R Dempster, 2204 Glen Ave, Berkeley, Calif

male was backcrossed to his mother and mated to a number of related females, and while the variation did not appear in the resulting litters, tests of representative animals derived from these matings showed that some were carriers Unfortunately, the doe of this pair and her sire died before similar tests could be made but in several matings with the same buck, the doe produced young showing the deformity Three litters containing 19 normal and 6 deformed animals were obtained in this manner, but despite continued efforts, including the use of foster mothers, only one deformed animal, a female, was raised to maturity

In typical cases of brachydactylia in the rabbit the toes of affected feet are shortened in the manner characteristic of the deformity in man, and x ray examination shows that the shortening is due to loss or shortening of the middle phalanx Minor deformities also occur in which shortening or loss of the terminal phalanges is the only alteration, but as a rule, the abnormality is more extensive than in typical cases of human brachydactylia There is usually shortening of the metacarpal or metatarsal bones, and the complete absence of all bones except those of the tarsal and carpal groups is of common occurrence Frequently, the entire foot is absent or composed only of irregular fragments of tarsal or carpal bones These conditions are present at birth, and definite deformities have been found in embryos during the third week of pregnancy The feet of these embryos were in a normal position and there were no adhesions or abnormal relations which would suggest intrauterine amputation

An especially important feature of this mutation is the influence exerted upon the long bones of the leg In all cases of marked abnormality of the feet so far observed, the bones of the corresponding leg, including proximal and distal segments, are markedly shortened and their diameters irregularly diminished as compared with those of unaffected members This condition is also present from birth and appears to be an integral part of the variation

Any one or any combination of the conditions described may be present in a given animal and any one or all feet may be affected Moreover, the progeny of given parents differ as widely in these respects as the progeny of different parents, so that at present there appears to be no relation between the location or character of the deformity presented by parents and by progeny

As mentioned above, there is evidence of a constitutional inferiority in the stock transmitting this abnormality The deformity itself offers no serious obstacle to a normal, healthy cage life, but losses of affected and unaffected animals during the first few weeks of life have been exceptionally high At birth they frequently show signs of retarded development or prematurity, such as deficient pigmentation and delayed growth of hair, others are obviously non-viable Most of the females are poor mothers and unless the young are fostered, they die shortly of starvation or exposure or are eaten by the doe Even with good foster mothers, the animals show an increased susceptibility to ordinary disorders and only a small proportion reach maturity

These animals also display reproductive abnormalities Thus the fertility of females and of heterozygous males is considerably lower than the general level of the colony, and less than 30 per cent of matings result in pregnancy Only two affected males have been reared to maturity One of these, a semi cryptorchid, has been mated repeatedly with does known to be fertile without a single pregnancy resulting The other possesses normal testicles but is an extremely pugnacious animal While numerous attempts have been made to secure matings, he has never manifested a desire to render service, but on the other hand viciously attacks the female

So far, genetic studies have been based largely on the progeny derived from the affected female mentioned above by crossing with an unrelated male Tests of three sons obtained in this manner have shown that all of them transmit the abnormality Eleven females were raised from the matings of one son with unrelated does and were backcrossed to him and to the other males Of these six proved to be transmitters and five produced only normal young in numerous litters, indicating that the male in question was heterozygous

Matings between heterozygous males and females have given 145 normal and 48 abnormal animals, which corresponds with the expected values of 144 75 and 48 25 for a simple recessive character

Backcross matings between affected females and heterozygous males have given a total of 50 young, of which 31 were normal and 19 abnormal This is an approximation to the expected ratio of normal and affected individuals, and the difference is not significant

The mutation described is apparently a simple recessive character which originated with the crossing of the two animals mentioned One of the parental lines was adequately tested for the prior existence of the mutant genes after the character was detected and the other was sufficiently investigated by an examination of breeding records and by test of closely related members of the line to render the previous existence of the mutation highly improbable The mutant character is of especial interest because of its close resemblance to well-known human affections with the

implication of a genetic relation in the series of abnormalities affecting the hands and feet and the definite extension of the developmental disturbance well beyond the site of obvious deformity The connection between the anatomical abnormalities and the functional disorders in these animals is uncertain Further studies may clarify these several relationships

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THE REDUCING POWERS OF PHYSIOLOGICALLY IMPORTANT CARBOHYDRATES

In view of the increasing attention paid to the rôle of the physiologically important sugars in body economy, it seemed worth while to determine the relative and actual reducing values of these sugars, using the newer techniques devised for the determination of glucose

The sugar methods employed were Folin's modification of the Folin Wu method[1], Somogyi's modification of the Shaffer Hartmann technique[2], the revised Folin Malmros micro sugar method[3], the Hagedorn Jensen ferricyanide method[4] and the new copper iodometric method (reagents) of Shaffer and Somogyi[5]

In this paper are presented a comparison of the reducing values of d glucose, l arabinose, d fructose d galactose, lactose (hydrate) and maltose (hydrate)

The sugars employed were all of the highest purchasable purity (Pfanstiehl brand) All the sugar samples were dried in a vacuum desiccator to constant weight and the purity checked by means of the polariscope All pipettes, sugar tubes and boiling tubes were calibrated Stock sugar solutions were made by accurately weighing out 75 milligrams of sugar and diluting in retested 50 milliliter volumetric flasks with one half saturated benzoic acid as a preservative From these 0.15 per cent solutions the proper dilutions for the techniques were made

The determinations were carried out for each method exactly as described for glucose, the glucose reference standard being made up to contain the same weight of material as the solutions of the other sugars

Since the sugar methods employed were designed primarily for the determination of glucose, the reducing powers of the other sugars are expressed in terms of this carbohydrate as unity

In Table I is presented a comparison of the relative reducing values of equal weights of the carbohydrates studied, while in Table II are given the results on the basis of equimolecular solutions, as calculated from Table I

TABLE I
A Comparison, to Glucose as 1, of the Relative Reducing Powers of Equal Weights of the Carbohydrates

	Method	Glucose	Arabinose	Fructose	Galactose	Lactose*	Maltose*
	New Folin Wu	1	0.65	1.05	0.75	0.41	0.40
	Somogyi Shaffer Hartmann	1	0.80	1.03	0.70	0.40	0.38
	Folin Malmros	1	0.96	0.98	0.82	0.47	0.39
Weinbach and Calvin	Hagedorn Jensen	1	0.87	1.02	0.74	0.67	0.75
	Shaffer Somogyi Reagent 50 1 gm KI	1	0.85	0.96	0.75	0.46	0.34
	Shaffer Somogyi Reagent 50, 5 gm KI	1	0.87	1.00	0.76	0.46	0.35

* One molecule water of hydration

TABLE II
A Comparison to Glucose as 1, of the Relative Reducing Powers of Equimolecular Carbohydrate Solutions (as Calculated)

	Method	Glucose	Arabinose	Fructose	Galactose	Lactose*	Maltose*
	New Folin Wu	1	0.54	1.05	0.75	0.82	0.80
	Somogyi Shaffer Hartmann	1	0.67	1.03	0.70	0.80	0.76
	Folin Malmros	1	0.80	0.98	0.82	0.94	0.78
Weinbach and Calvin	Hagedorn Jensen	1	0.73	1.02	0.74	1.34	1.50
	Shaffer Somogyi, Reagent 50, 1 gm KI	1	0.71	0.96	0.75	0.92	0.68
	Shaffer Somogyi, Reagent 50, 5 gm KI	1	0.73	1.00	0.76	0.92	0.70

* One molecule water of hydration

The order of reducing power in general, for all

1 O Folin, *Jour Biol Chem* 82 83, 1929
2 M Somogyi, *Jour Biol Chem* 86 655, 1930, 70 599, 1926
3 O Folin and H Malmros, *Jour Biol Chem* 83 115 1929
4 H C Hagedorn and B N Jensen, *Biochem Zeitschr* 135 46, 1923
5 P A Shaffer and M Somogyi, *Jour Biol Chem* 100 695, 1933

the methods, per equal weight of sugar is *fructose* or *glucose* > *arabinose* > *galactose* > *lactose* > *maltose*. The order of reducing power per molecule is *fructose* or *glucose* > *lactose* > *maltose* or *galactose* > *arabinose*.

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A NEW CANKER DISEASE OF RED PINE, CAUSED BY TYMPANIS PINASTRI[1]

RED or Norway pine (*Pinus resinosa* Sol.) is to day one of the most important of our native coniferous trees for reforestation purposes. Its silvicultural importance has been largely responsible for its wide use, but its freedom from serious disease has been at least contributory. Therefore, any new disease is of immediate interest and needs thorough investigation.

During the winter of 1932–33 a small area was observed in the Eli Whitney Forest (the watershed property of the New Haven Water Company, New Haven, Conn.) where the red pines were dead and dying. Subsequent studies have shown that the causal organism is *Tympanis pinastri* Tul. A preliminary report of these studies and a brief summary of the more important results are given in this article.

On red pine the disease is characterized by the formation of axially elongated stem cankers with or without definite margins and with depressed centers which become roughened and open after two or three years. The absence of any marked resinosis in or adjacent to the cankered tissue is noticeable. Each canker is centered at a node and always has one or more central branch stubs, indicating that the organism enters the stem at the bases of lateral branches. Because of the absence of cankers on the centrally located branches it appears that the fungus exists there primarily as a saprophyte and grows into the stem and produces cankers only when the host is weakened by some environmental factor. Infection has been found only in southern Connecticut in plantations established from 1916 to 1919.

The same fungus is associated with cankers on northern white pine (*P. strobus* L.), but on this host infection is limited to trees which are greatly weakened through shade suppression, root competition, poor soil or some other similar cause. Occasional cankers on white pine have been observed throughout New England and in New York and Maryland.

The fructifications of *T. pinastri* are glistening black cartilaginous bodies. They occur on practically all cankers on both hosts, but because of their small size—up to 1 mm in height and breadth—they may not be noticed unless one is particularly and closely searching for them. They are of two kinds—ovate or spherical pycnidia on a stromoid base and disk-shaped stalked apothecia. The presence of either is sufficient to identify the organism.

The parasitism of *T. pinastri* on red pine has been definitely established through artificial inoculation experiments. Pure cultures were secured from the fructifications and from inner bark mycelium from both red and white pines. Two hundred and twenty one inoculations and 35 checks were made on 56 thrifty red pines in May, 1934. Examination of the inoculations in late September showed that small but typical cankers were present in a few cases and that fructifications were present in nearly all cases. At the same time the checks were sterile. The fungus has been reisolated in pure culture from the artificially induced cankers. No attempt has been made yet to inoculate white pines.

Studies now in progress indicate that the disease on red pine is present only in plantations, that it is much more prevalent in pure stands than in mixtures with white pine, that it is not limited to the poorer sites but may occur on the upper crown classes more on poor sites than it does on good sites, that on all sites the lower crown classes are much more susceptible than the upper ones, and that its incidence seems to be definitely correlated with the severe drought of 1930 in southern New England. It is to be expected that another period of infection need not be anticipated until another serious drought occurs.

Further studies of this disease are now under way. The writer would appreciate any information concerning diseased red pine trees or stands. Collections of *T. pinastri* or of closely related fungi on coniferous hosts are also requested.

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[1] Contribution from the Osborn Botanical Laboratory, Yale University, in cooperation with the Northeastern Forest Experiment Station. Published with permission of the Secretary of Agriculture.

BOOKS RECEIVED

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SCIENCE

VOL. 81 FRIDAY, MAY 3, 1935 No. 2105

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

ADDRESS OF THE PRESIDENT OF THE NATIONAL ACADEMY OF SCIENCES[1]

By Dr. W. W. CAMPBELL

PRESIDENT EMERITUS OF THE UNIVERSITY OF CALIFORNIA

Mr. Minister of Norway,
Members of the National Academy and esteemed Guests:

WITH one exception the several speakers of this evening will be formally introduced, and you will observe that their addresses fit into a logical plan. It will make me feel better if I exercise the privilege of telling you that I, as the one exception, am making an address at the request of the academy's council, and not upon my own initiative.

The academy's dinner of each year is attended for the first time by many of its recently elected members. It is a safe guess that those new members have an incomplete understanding of the historic reason for the academy's creation and existence. It was in the middle year of our great war between the states, the year 1863, that the United States Government, feeling the need for a definite and responsible organization of the scientists of the nation to which it could go at any time for information and advice on scientific subjects, incorporated and constituted the National Academy of Sciences, by a special Act of Congress. This act, in effect the charter of the academy, is a remarkable document, remarkable in its brevity, its clarity and in my opinion its wisdom.

The first paragraph of the congressional act consists of the statement that fifty American scientists whose names are recorded in alphabetical order, beginning appropriately with Louis Agassiz, of Harvard, on the Atlantic coast, and ending with "J. D. Whitney, California; their associates and successors

[1] Given at the annual dinner, April 23, 1935.

duly chosen, are hereby incorporated, constituted and declared to be a body corporate, by the name of the National Academy of Sciences"

The remaining fifteen lines of the printed charter contain five specifications, which I shall now quote, and briefly comment upon

Firstly, the National Academy of Sciences shall consist of not more than fifty ordinary members" The Congress, in 1870, removed the limitation placed upon the number of ordinary members and the Academy has itself fixed the limit, for the time being, at three hundred The actual number is now 275, of whom two are women There are also forty four foreign associates, that is, honorary members, eminent scientists of other nations

Secondly, ' the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated" The academy's annual meeting is held always in the city of Washington, in the month of April The academy holds a stated meeting in the autumn of each year, always at some center of higher education or research activity other than Washington It met last November in Cleveland It will meet next November at the University of Virginia

Thirdly, there is the specification which defines the purpose, apparently the sole purpose, of the Congress in establishing the academy, namely ' the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art (meaning the practical arts), the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States"

As an unwritten corollary to this specification, I may say for the special benefit of our newer members that the American citizen, the American scientist, who accepts election to membership in the academy tacitly agrees to respond to the Government's call for the study of, and report and advise upon any subject lying within his field of special interest, and without expectation of financial recompense for his services In the 72 years of its existence the academy has complied a great many times to requests from the government for information and advice, gladly, and as promptly as practicable, on problems exhibiting a wide range of character and magnitude The academy, naturally and in accord with the expectations of the Congress in 1863, is uniquely prepared to meet the Government's needs To describe one recent case in illustration of that fact When the National Planning Board, operating under the auspices of the Interior Department, on April 24 of last year, formally requested the National Academy of Sciences to advise it concerning "The Rôle of Science in National Planning," the academy's report to be made available to the board well before the close of June, I assigned the duty of conducting as comprehensive a study of the subject as the time limitation would permit, and of preparing the report, to the academy's standing Committee on Government Relations, consisting of John C Merriam, *chairman*, the president and the vice president of the academy, the chairman of the National Research Council, the chairman of the academy's eleven several sections, and the chairman of the Division of Federal Relations of the Research Council—a committee of sixteen members representing, very appropriately in this particular problem, every one of the principal fields in the domain of the physical and the biological sciences At the same time advantage was taken of the academy's constitutional provision which says that "It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments not members of the academy," to add to the resources of the committee the valued knowledge, experience and judgment of twelve distinguished scientists not members of the academy, and also of eleven additional academy members, making a total personnel of thirty nine The committee's report, published in the Academy's Annual Report for 1933–34, was finished, thanks largely to the chairman's energy and executive ability, and transmitted by the academy to the Planning Board on June 18, fifty five days after the date of the request

Recalling that the academy's members number about 275, and that they represent in reasonably normal proportions the several physical sciences and biological sciences, including medicine, psychology and anthropology, a modest application of arithmetical division suggests that the academy could, in case of emergency call constitute a full score of committees composed of a dozen academy members each, without any overlappings of personnel and without requisitioning its aged members This is an imaginary "setup" of committees it will probably never occur in fact The academy's collective membership represents uniquely in the United States a great reservoir of knowledge, experience and tested judgment on scientific subjects, and much can be said as to the wisdom of the Congressional plan that "any department of the Government" may call upon the academy for information and advice upon questions in any division of the physical sciences and the biological sciences Academy committees can be, and always have been, constituted each in excellent accord with the nature of the problem involved

It is a universally recognized fact that governments may count upon obtaining the most dependable advice,

in general, from institutions which are independent of political considerations and relationships, and whose members have no political interests except those possessed by all good citizens, and no financial or other material concern with the outcome of studies conducted for the government. I do not know of any other group of citizens of the republic who are so universally contented with their present lot as are the members of this academy. Using some ponderous language, I may proudly say that they are all interested in the eternal verities! They have been seeking the truth, as represented by scientific facts and principles, and they have been fairly successful in their quests, otherwise they would not be members of the academy. Looking in the opposite direction, I regard it as essential to the welfare of the academy, through the decades and centuries which lie before it, that the academy be at all times completely free of political elements in its organic and administrative relationships. I think the Congress of 1863, perhaps in response to the advices of some of the wise men who were prospective charter members of the academy, must have realized the importance of this condition, for,

Fourthly, there is a specification in the academy's congressional charter which says that the "corporation (*i.e.*, the National Academy of Sciences) hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regulations; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and"

Fifthly, the specification that the academy "report the same to Congress."

The charter conditions that the academy govern itself in all things, and that the academy receive no compensation whatever for any services to the Government of the United States, are precisely as they should be, as both the fundamental purposes of our institution and the traditions and experiences of similar institutions in the capital cities of other nations clearly proclaim. In confirmation of these facts, I can not do better than to quote from the annual address delivered by the president of the Royal Society of London, Sir William Huggins, in the year 1904. The Royal Society

asks for no endowment from the State, for it could not tolerate the control from without which follows the acceptance of public money, nor permit of that interference with its internal affairs which, as is seen in some foreign Academies, is associated with State endowment. ... The financial independence of the Royal Society, neither receiving nor wishing to accept State aid for its own private purposes, has enabled the Society to give advice and assistance which, both with the Government and with Parliament, have the weight and finality of a wholly disinterested opinion. I (the President of the Royal Society) may quote here the words of a recent letter from His Majesty's Treasury: Their Lordships have deemed themselves in the past very fortunate in being able to rely, in dealing with scientific questions, upon the aid of the Royal Society, which commands not only the confidence of the scientific world, but also of Parliament.

The Royal Society received its royal charter in the year 1662, and it was therefore 242 years old when President Huggins thus spoke. The Royal Society has had long experience, and it is very wise.

I have regarded the charter of the academy, received by gift of the Congress, as a trust closely approaching the sacred, to be violated or disregarded at the academy's peril. In accordance with the specific command of its charter from the Congress, the academy reports annually to the Congress.

The charter contains one clause which, speaking in a familiar manner, may be interpreted as a blanket provision conferring unspecified powers: "the National Academy of Sciences shall ... have power ... to provide for ... all other matters needful or usual in such institution." It is thereby permitted, and may have been intended by its founders, that the academy shall be active in encouraging the extension of knowledge in the domain of the physical and the biological sciences, through research and discovery: firstly, by making a high degree of success in this field of endeavor the principal and essential criterion for election to membership in the academy; secondly, by the description and the interpretation of research results achieved by its members and other invited scientists, through the medium of papers presented at the academy's meetings; thirdly, by awarding medals and honoraria to members and non-members in recognition of notable research achievements, or for applications of science to the public welfare; fourthly, by making grants of money to members and non-members for the support of definite and promising research plans from funds which will have come to the academy by gifts and bequests; and in yet other ways. These things the National Academy has done with commendable success, as have also the leading academies of sciences in other nations.

In the first three decades of this century, and earlier, there was wide-spread recognition of the obvious fact that scientific discoveries and their applications were contributing enormously to the physical comforts and the material well-being of the peoples who dwell in what we may call the scientific nations.

scientific discovery, directly and indirectly, was responsible, above all other influences combined, for the raising of the standards of living and the lengthening of the average span of human life, in the astonishing degrees we are all aware of. Within the past three or four years, however, scientific discoveries, and especially the accelerated speed with which such discoveries had recently been made, have been under some degree of suspicion as to their resultant values to the human race. People in great and unaccustomed numbers have been suffering privations, both physical and spiritual, and they have been looking for the sources of their misfortunes. Scientific discoveries, coming too rapidly, have been blamed. However, the accusations have been made more or less irresponsibly, and apparently without basis of serious and comprehensive thought, or verified fact, for discoveries in science are but truth uncovered, truth which had been existing and operating a long, long time, though we didn't know it and we have suffered no harm in suddenly learning about it.

It is doubtless true that advances of knowledge in the fields of the various sciences have, through their applications to the affairs of the world, subtracted from the demands for human labor in some of the older industries, but it should be remembered that these applications have to their credit the creation and development of new activities, many and on relatively large scales, which have undoubtedly given employment to greater numbers of both men and women than had been displaced from the earlier activities.

What is quite another thing, the applications of labor saving machinery in factory and mill, on the farm and elsewhere, have with apparent reason been blamed for some of the ills of the world. Early in June, 1928, full sixteen months before the financial slump of October, 1929, I heard an able and well informed man quote to a small but distinguished audience in New York City the indisputable evidence that in the few years then just passed, a great many thousands of workmen, both skilled and unskilled, in mills and factories had been displaced by labor saving machines, displaced so rapidly that they failed in large measure to secure other positions, and that already there was much suffering in consequence. The speaker, whom many of you know very well, said in substance to the men before him, many of whose names are as household words to you: "If these conditions can develop and exist in the period of greatest manufacturing activity ever experienced in our country, what will happen when years of economic depression arrive? I ask and urge," said the speaker, "that you men of large affairs and wide experience give thought to the great problem which seems to lie ahead of us."

The predicted problem of unemployment and its dire consequences has certainly been with us, through the past five years. However, the labor-saving machinery under suspicion had but little relation, and much of it absolutely no relation to recent discoveries in science. For example, we have all seen labor-saving machinery at work in the construction of modern highways, and on the farms which certainly had no relation to recent discoveries in science![2] Rather were the offending machines, with relatively few exceptions, the products of mechanical engineers' and electrical engineers' inventive genius, aroused by the urge of the great war's abnormal demands and later by the urge of competition perhaps due in some measure to low wages in other lands and relatively high wages and other conditions at home. I do not pursue the subject further because, in my opinion, it lies almost wholly within the immense and important domain of economics and the social sciences.

There is one superlatively important consequence of discoveries and developments in the physical and the biological sciences which seldom gets any description or discussion in books and newspapers read by people in general. In preceding paragraphs I have been treating of science chiefly in its "bread and butter" aspects. I here refer to the profound influence of scientific discovery, through the decades and the centuries, upon our modes of thought, upon our freedom of speech and freedom of search for the truth, upon our ways of looking at life and life's affairs. The subject is a most tempting one, and if time were abundant, as it is not, I should have liked to develop it, but I must limit myself to a few more or less disconnected illustrations and statements.

Nearly forty years ago, while on a scientific mission in central India, I camped in a region whose people were suffering from their second year of famine. I could not induce any of the emaciated millions of Hindus around us to accept a slice of bread or a can of peaches because, for reasons attaching to their caste system, all our food, from their point of view, was unclean in the theological sense, and to eat it would destroy their chances of happiness in the world to come.

The Hindus and the Mohammedans and the other "fatalistic" peoples, with relatively few exceptions, have been falling far behind with respect to what we make bold to call world progress, not because they

[2] After this address was finished, I learned from *Time* for April 22, pages 36–38, that a machine for picking cotton, in replacement of human labor, has been invented and subjected to successful test. *Time* says that "In seven and a half hours it gathers as much cotton as a diligent hand picker gathers in an eleven week season." I doubt if it bears intimate relation to any recent discovery in science, but the subject might easily become one of vast importance, economically and politically.

have been retrograding in the absolute sense, but because the other peoples have relatively forged ahead Their disadvantages have lain less in their failure to profit from the material benefits of applied science than in their holding to the mystical philosophies of old, which are "fatal" to progress The essence of the philosophy of science is the cause-and effect principle The tenets of the scientific spirit tell us, whenever we are dealing with really serious matters, to "Prove all things, hold fast that which is good"

The year 1859, three quarters of a century ago, marked an astonishing epoch in the intellectual history of the world, in no previous year had so much been done to liberate the spirit of man In that year was published the "Origin of Species", in that year were discovered the principles of spectroscopy It is true that many of the ideas on evolution antedated Darwin, but Darwin's systematized and fortified ideas took root, and thenceforward there developed rapidly the hypothesis, and I might almost say the conviction that the principles of evolution are applicable to nearly all—perhaps all—things to our ideas on almost any subject, certainly to the religions and the theologies of the earth's peoples, to the earth, in that it is not only very old, and the result of evolutionary processes, but that the earth's surface features and all things upon the earth are changing, more or less slowly evolving, in orderly manner, with the passing of time Some of the revelations of the spectroscope antedated Kirchhoff, but with the ability to interpret spectroscopic observations of the sun, of the other stars, of the nebulae, there came rapidly a realization of the unity of the great universe The earth is not only not flat, it is not the center of the universe, it is just one of the sun's smaller children, our sun itself is just a humble star among the billions of stars in our own stellar system, and there are, at the least, many tens of millions of other stellar systems These are facts, established at the cost of great labor, and they have influenced and modified our ideas and attitudes most profoundly No longer do we repeat the old dicta, "We shall never be able to know the chemical composition of the stars", "The conditions existing in the deep interior of the earth must forever remain unknown", and many similar beliefs of the last century and earlier

The dread malady, diphtheria, now comes to a very low percentage of families, but with every comprehending family there resides an inspiring appreciation of the values beyond price which reside in the antitoxin made available by scientific research Relatively few families have members or friends at sea, but every intelligent family finds mental and spiritual comfort in the knowledge that wireless telegraphy is ever alert to rob the oceans of their most cruel terrors Our physicists have not yet learned what electricity really is, but I think they hold to the expectation that they or their successors will some day find out what it is Their discoveries about the constitution of the atoms and the ways of their constituent parts promise to be as marvelous as the modern developments of astronomical knowledge At any rate, the physicists know much more about electricity than the astronomers do about gravitation We know something of what gravitation is doing, and of what it will do, but we seem to know nothing about the mechanism of its action, nothing of the technical reason why it exists Of all the forces known to man, gravitation is marvelous beyond compare The velocity of light and of electricity, 186,000 miles a second, seems to be a snail's pace in contrast with the effective speed of gravitational action Pulses of light, emitted by the sun, require 500 seconds for their journey to the earth, whereas the sun's gravitational pull upon the earth, compelling the earth to travel in its elliptic orbit, seems to act instantaneously across the gap of 93 millions of miles At any rate, the tests of that hypothesis have been many, and not one of them has given or suggested an answer to the contrary The gravitational action of two bodies upon each other seems not to be affected or modified by the placing or presence of other bodies, no matter how massive, between them a pebble at my foot at midnight and the farthermost atom of calcium on the far side of the sun are thought to attract each other precisely as they would if the entire body of the earth, save that one pebble, and the entire body of the sun, save that one calcium atom, were annihilated and non existent The strength of the mutual gravitational pull of two bodies seems not to depend upon their temperatures, their magnetic states or any other known conditions

I have mentioned these well known facts not at all for the information of any single member of this intelligent audience, but to link a few of the many marvelous accomplishments of the past with some of the outstanding mysteries of the present, in illustration of the spirit of science which says that research will proceed in the hope and expectation that with the passing of the centuries and the millennia the greatest of mysteries in our surroundings on the earth and in the universe will one by one be resolved Why should we not have confidence that many children of to-day will live to see all the infectious and contagious diseases, including infantile paralysis, banished from the earth, through the discoveries of medical science and the administrations of public health services? Why should not man aim at an ever more complete comprehension of the universe in which he is living and working? I think we are all in accord with the thesis that the vast body of known truth about our

surroundings, as revealed by the ways and the means of the physical and the biological sciences, is incomparably more wonderful and inspiring than the fiction of the most lively imagination and, being idealistic and non-materialistic in character, is of the imperishable treasures of the human race

MEDALS OF THE NATIONAL ACADEMY OF SCIENCES

PRESENTATION OF THE AGASSIZ MEDAL FOR 1934 TO HAAKON HASBERG GRAN

WHETHER we ourselves be physicists, chemists or biologists, I think we will all agree, as living beings, that no question of sea science is more intriguing than how the inhabitants of the waters manage to survive in the waste of waters And if we follow the life chain backward far enough we come at last to the question What it is that governs the productivity of the sea for the microscopic floating vegetation which serves as eventual sustenance for all the animals of the sea? If all flesh be grass, it is as nearly true that all fish be diatoms It is in this most significant field that Haakon Gran has delved, until his name and fame are as familiar to students of marine biology as is his genial countenance to many of us here

Gran's earliest scientific papers were along somewhat other lines, for he opened his productive career as a student of the taxonomy and distribution of diatoms, a field in which he soon attained high eminence He commenced his scientific authorship in the last years of the past century, in 1902 came his famous monograph on the plankton of the Norwegian sea, where he traced for the first time the relationship that the communities of floating plants bear to the various water masses through the seasons for so extensive an area By 1908 he had produced his well known handbook of the marine planktonic diatoms In 1912 there followed what still remains the best rounded account of the vegetable plankton of high seas that has appeared, based on his own field studies on the transatlantic expedition of the *Michael Sars* And he has ever since continued adding to our factual knowledge of the microscopic plants of the oceans, far and wide

All this, however, expresses but one side of Gran's scientific life Even in his earliest papers, while a young student, we see him concerned with the sudden and spectacular increases and decreases in the amount of planktonic vegetation in northern seas, and with the wide variations that may exist in this respect within short distances, the occurrence of which was already well known, but for which no explanation had previously been suggested Influenced, perhaps, by the Norwegian oceanographers Nansen and Helland-Hansen, he early saw that advances here, as in the physics of the sea, awaited the development of a precise quantitative technique Experience followed with the centrifuge method, introduced shortly previous by Lohman, with such rich results By 1912 Gran had combined this procedure with a satisfactory technique for preservation, and provided his fellow students with a tool, by means of which the whole water mass, top to bottom, can be as precisely examined for its content of microscopic plankton as for its temperature or for its salinity Use of this tool far and wide, from seaside laboratory and deep sea expedition, has vastly enlarged our knowledge of the quantitative distribution of planktonic organisms, and Gran has himself introduced it to American waters

By that date Brandt's theoretic application, to the sea, of Liebig's law of the minimum, had been widely accepted as a working hypothesis, while Nathanson's suggestion that updrafts of chemically rich water from the deeps bring fertility to the surface zone where plants can live was exciting attention These threads Gran drew together, showing that the seasonal cycle of plankton production in North European seas is explicable only on the assumptions that variability in the chemical fertility of the water is in fact a controlling factor, that different water masses and depths do differ in this respect, and that the fertility of the surface waters alters from season to season

Evidence for his far reaching concept had so far been indirect, no adequate methods having been available for measuring the richness of the water in the substances presumably concerned But the introduction by Atkins and Harvey of improved chemical technique brought ample confirmation for studies of the relationship between plankton and chemistry of the water, at many hands (including Gran's own), in different seas, it was soon proved that the picture outlined earlier by Gran and his associates was essentially correct, or, as Gran puts it, that "most of the differences in the productivity of various areas in the sea can be explained from the distribution of the nitrates and phosphates" So close, in fact, was the parallelism found between the ups and downs of the planktonic plants and of the nutrient substance most easily measured, and so attractive to the human mind is simplicity to account for complexity, that many of us were tempted to think we had found the uni-

versal cure-all for our perplexities Chiefly to Gran and to his students do we owe our present realization that, though the underlying principle prevails, such simplicity never exists in the sea, but that the basic balance is everywhere confused by disturbing factors, in much more complex interaction Most recently and in our own home waters Gran has shown how one particular type of oceanic circulation, highly favor able to plant growth when moderately developed, may be highly detrimental when too active

Time does not allow me to speak of Gran's career in more detail I can only mention his investigations of the causes for the fertilizing effect which land drainage appears to exercise upon the sea, his experiments on the total production of organic matter in sea water and on the cultural requirements of marine plants, though these have far reaching implications

But I hope I have said enough to show that the growth of knowledge of the fertility of the sea bears always the impress of Gran's guidance, in amassing facts, in developing hypotheses and in testing theory against observation with such sureness of vision that he now stands, acknowledged, a leader among students of the ocean In this, he has done no small thing It is for this that the Academy delights to honor him with this beautiful medal

HENRY B BIGELOW
WOODS HOLE OCEANOGRAPHIC INSTITUTE

PRESENTATION OF THE HENRY DRAPER MEDAL FOR 1934 TO JOHN STANLEY PLASKETT

IN 1872, Dr Henry Draper, of New York, employing a small reflecting telescope he had himself constructed, secured the first successful photograph of a star's spectrum Then with the advent of the far more sensitive dry plates this new method of learning of the chemistry and physics of the stars was to have a very fruitful development. Unfortunately, Dr Draper did not live to realize how important was to become this new research field he had opened But Mrs Draper continued to be keenly interested and gave substantial encouragement to the new astrophysical studies which to-day bring us so much intimate knowledge of the stars And so we have among other memorials the Henry Draper Fund of the National Academy of Sciences, which seeks to aid and encourage this branch of research And it is my duty and pleasure to say a few words touching upon the academy's action in awarding this year the Henry Draper Medal to Dr John Stanley Plaskett, director of the Dominion Astrophysical Observatory, Victoria, Canada.

Dr Plaskett's life-work has been very closely in the field in which Dr Draper was so prominent a pioneer

Dr Plaskett's consistent and fruitful program of stellar velocity observations, which he has conducted with exceptional skill and energy, and the important conclusions he and his colleagues have deduced from this rich observational material have afforded substantial scientific grounds for this award to him Moreover, our medalist must be credited with outstanding success in another direction for it was due to his foresight, conviction and diplomacy that the Canadian National Government became persuaded the people of Canada should have a large reflecting telescope Thus the great Dominion Astrophysical Observatory—with its excellent 72 inch reflector—stands as a memorial to his vision and his steadfastness of purpose Thus Dr Plaskett has won a high standing and this splendid observatory has already developed traditions and a position of high repute among the world's leading observatories

V M SLIPHER
LOWELL OBSERVATORY

PRESENTATION OF THE DANIEL GIRAUD ELLIOT MEDAL FOR 1932 TO JAMES P CHAPIN

JAMES PAUL CHAPIN is one of those fortunate human beings who was born with that affinity for birds which characterizes the true bird lover The very term itself suggests the character of the relation that exists between a person so blest and the forms of life which so strongly attract him

One never hears of a mammal lover or a snake-lover, a fish lover or even a butterfly lover But love of birds is as definite a heritage as that of the musician or the artist This legacy, a gift perhaps from the remote ancestors to whose untutored minds birds were signs and symbols of the mysterious manifestations of nature, has been the dominant influence of Chapin's life As a child it sent him to the fields and woods As a boy of sixteen years it prompted him to enter the department of taxidermy of the American Museum of Natural History There he acquired the technique of what was to become his profession But he soon discovered that while a bird-lover is born the ornithologist is made, and the following year (1906) he entered Columbia University to acquire the general training and the broad knowledge of biology on which his studies of birds might be based

In his junior year he left college to accompany the American Museum's expedition to the upper Congo, where he secured the most valuable and best prepared collection of birds that has been made there, together with an unequalled knowledge of their habits

Returning to New York benefited by his five and a half years' residence in the heart of darkest Africa, Chapin at once resumed his studies at Columbia, received his A.B in 1916, his A M in 1917 In the

latter year he enlisted in the American army and served in France as zone major for the duration of the war

After receiving his discharge from service, Chapin returned to Columbia for his doctorate and, escaping the lure of Drosophila, was given his Ph.D. for a thesis on his African bird studies, the only degree in ornithology that the university has granted

There followed additional years of study before the publication of the book (the first of three volumes) for which Chapin is now honored

The work of a man exceptionally qualified by desire, natural gifts and experience gained in nature, the museum and the classroom, it records in detail observations on habits and distribution, the result of prolonged field work, it discusses questions of taxonomy and of nomenclature from the standpoint of the skilled systematist who has access to many specimens and is familiar with the literature of his subject, and it treats with the authority of the trained biologist those problems which arise in attempting to explain the relation of an animal to its environment

Here, Mr President, is an outline of the facts and factors which have induced the members of your committee to recommend the award of the Elliot Medal to James Paul Chapin

FRANK M CHAPMAN

AMERICAN MUSEUM OF NATURAL HISTORY

PRESENTATION OF THE PUBLIC WELFARE MEDAL TO AUGUST VOLLMER

IT is a commonplace to day to remark on the disparity between our knowledge and control of the physical forces of nature, and our knowledge and control of social forces

Three centuries of scientific effort have won basic understandings of physical behavior, and have replaced superstition and appeal to authority by rational viewpoints But it is vastly more difficult to make progress in the understanding of social forces, and the solution of social problems Here prejudice is more deeply intrenched, selfishness and provincialism more completely determinant of mental attitude

However great these difficulties may be, we have faith that surely, even if very slowly, knowledge and mastery are to be gained through the method that we term scientific

To night we honor a man whose service has been given to a social problem of critical importance in that difficult field, and who is applying to that problem the spirit and the technique of science

Crime is a disease of society and August Vollmer a clinician who has stimulated the application to the problems of criminology and police administration of all that can be gathered from the realms of exact knowledge His achievements have been noteworthy and of wide influence They constitute, using the language of the purpose of the award of the Marcellus Hartley Medal, "eminent service to the public, performed without a view to great monetary gain, and by methods which are truly scientific"

Vollmer's work began and continued for many years in the police department of Berkeley, where, with but limited resources, pioneering demonstrations of scientific techniques were made After a few years at Chicago, he returned to Berkeley, where now, as professor of police administration, he is engaged in the effort to bring the university's resources to the improvement of the administration of criminal justice

By these years of effort, Vollmer has shown the way to the elimination of graft and spoils in police administration, has elevated the standards of personnel, and inspired his co workers with pride in and ambition for their profession He has stimulated the search of all fields of science to bring them to bear on the problems of crime detection and prevention It is not too much to say that he has been instrumental in the veritable remoulding of a profession

Such results bear testimony to Vollmer's qualities He brought to his work persistence, intelligence and human sympathy without sentimentality His unselfishness and modesty have been important factors in the acceptance of his demonstrations, and of his wide spread influence

These achievements in the difficult and once unpromising field of police administration have far reaching results Respect for law and order grows with the efficiency and character of their formal guardians, and every successful performance of a difficult function stimulates the faith and confidence of a people in its government

MAX MASON

ROCKEFELLER FOUNDATION

ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING OF THE NATIONAL ACADEMY OF SCIENCES

Lability of the basal metabolism of the dairy cow FRANCIS G BENEDICT AND ERNEST G RITZMAN The basal metabolism of five Holstein (ca 600 kg) and four Jersey (ca 300 kg) cows, ranging in age from 3 to 15 years, was measured in 24 hour periods on the fourth and fifth days after the withdrawal of food At this

stage of fasting the respiratory quotients approached that of fat and the methane production was very low Before their fasts the cows were fed for at least three weeks on maintenance or somewhat better than maintenance rations, consisting of roughages alone, concentrates alone or green grass (pasture) At no time were they undernourished The roughages included six different hays, of varying protein content and of early and late cuttings The concentrates given were either corn meal alone or linseed meal supplemented by wheat bran The cows were at all times kept at a controlled environmental temperature of about 20° C In the majority of instances they were dry, in a few cases pregnant or lactating The experimental series with any one animal extended from two months to one, two or (with two cows) three and one half years None of the cows underwent a change in body weight greater than 15 per cent except in one instance, when the weight increased 28 per cent within a year's time The basal heat production per 500 kilograms of body weight, expressed on the basis of lying per 24 hours, varied from 10 per cent with a dry cow (measured only twice) to 90 per cent with two dry cows measured repeatedly over a period of several years In eight instances with four cows (non lactating) a marked change in fasting metabolism (either a decrease or an increase), amounting to from 30 to 85 per cent occurred within two months, when there was no pronounced change in body weight and the animals could not possibly have altered appreciably in body composition The greatest changes in metabolism occurred during lactation and especially with the change from hay to pasture feeding or *vice versa* In view of the clearly demonstrated lability of the basal metabolism of these dairy cows the concept of constancy in basal metabolism of animals, which has prevailed among physiologists in general for so many years, must of necessity be revised and the possibility should be recognized that great changes in the endogenous metabolism may take place even within a relatively short time without concurrent changes in body weight

Heat losses from the human body EUGENE F DU BOIS and JAMES D HARDY An analysis of the modes of losing heat from the body surface is important in understanding the mechanism for control of body temperature and the production of fever Experiments carried on for the past twenty years by the Russell Sage Institute of Pathology with its calorimeter have eliminated much uncertainty as to the relation of the heat produced in the body to that eliminated from its surface and have carried the analysis of heat losses to the stage where it is known that under the standard experimental conditions about 24 per cent of the heat lost is by means of vaporization of moisture The development of an accurate instrument for the measurement of radiation permits us to estimate the amounts of heat lost through all channels The proportions of heat lost by radiation, conduction and convection and vaporization are found to depend upon many factors The physical factors include temperature of the air, of the walls of the chamber, humidity, air velocity, clothing and surface area exposed. Physiological factors include total heat production, vasomotor control and state of health Measurements on a group of lightly clothed subjects while lying quietly in the calorimeter for periods of three hours show heat loss distributions as follows Radiation 60 per cent vaporization 25 per cent, convection 15 per cent These proportions hold fairly well for clothed or unclothed subjects if the environmental temperature be kept between 77° F (25° C) and 81° F (27° C) Out of this range the effect of clothing is quite marked Without clothes shivering usually occurs after several hours exposure to an environmental temperature below 75° F and visible sweating at temperature above 82° F The quantitative study of convection has explained several paradoxes and has thrown light on Rubner's law of surface area

Some remarkable ciliate Protozoa from the caecum of the Indian elephant C A KOFOID The caecum of the Indian elephant contains two very remarkable new genera of commensal ciliate Protozoa named Polydinium and Elephantophilus These new genera represent the highest level of evolution as yet discovered in the family Ophryoscolecidae, which includes many commensal species in the stomach of ruminants and in the caecum of other herbivorous mammals *Elephantophilus zeta* has a Z shaped macronucleus which at division, reverts to the primitive club shaped form found in *Polydinium mysoreum* and generally throughout the Ophryoscolecidae Both of these new genera have multiple spirally curved ciliary zones arranged in a secondary bilateral grouping instead of a single dorsal zone found elsewhere in some other genera of the family There are five such zones in Polydinium and six in Elephantophilus Prior to binary fission new ciliary zones are interpolated between the old Multiple contractile vacuoles are distributed along these zones of motor activity in both genera Prior to fission, new vacuoles arise along the new interpolated zones These metameric structures and their adjacent excretory vacuoles provide a powerful spiral mechanism for boring locomotion through the comminuted vegetable contents of the caecum, among which they ceaselessly move and on whose cellulose fragments and other Protozoa and bacteria they feed The evolution of structural complexity in the commensal protozoan fauna of herbivorous mammals has advanced along with that of their hosts

Diabetes in relation with anterior hypophysis W G MACCALLUM Much experimental work bears upon the governing relation of the anterior hypophysis in the control of carbohydrate metabolism Certain authors maintain the existence of a secretion neutralizing insulin, while others attempt to show that the hypophysis stimulates an outpouring of blood sugar by way of the adrenal medulla so that the essential is a balance between the activity of the islands of Langerhans and the adrenal medulla. A chart representing these relations is illus

trated by the description of a case in which recovery from diabetes resulted from the establishment of a balance by the later atrophy of part of the anterior hypophysis

Maternal influence upon longevity and upon the incidence of leukemia in mice E C MACDOWELL (introduced by A F Blakeslee) In reciprocal matings between two highly inbred contrasting strains of mice, the average length of life in the first hybrid generation (683 *vs* 545 days) differs by 138 ± 11 5 days, which is 12 times the probable error The data behind these averages form frequency polygons of closely similar shape but with distinctly different ranges and with modes differing by three 50 day classes Each sex of offspring alone gives similar results, no consistent sex difference in age is demonstrable In one type of the cross 6 fathers and 17 mothers produced 166 young in the reciprocal cross 11 fathers and 21 mothers produced 140 young These two sets of F_1 hybrids also differ significantly in the incidence of spontaneous leukemia as recently reported The incidence of leukemia and length of life are inversely related both vary toward the mothers' strain While the incidence of leukemia in both directions of the cross lies between the parent strains, the age in both cases averages about 100 days above the mothers' strain leukemic mice from the reciprocal matings differ as much in length of life as the non leukemic mice These results speak against a causal relationship between the two sets of observations Reciprocal matings in a back cross give similar general results Both length of life and incidence of leukemia differ significantly according as they are brought in from the grandmother by the father or the mother Comparisons between the two hybrid generations showing groups with the same age and markedly different incidence of leukemia give further evidence of the physiological independence of these traits and indicate differences in the mode of transmission Through the male line the incidence of leukemia in two hybrid generations shows a correlation with the total heredity from the leukemic strain, transmission through females raises this incidence Longevity is also modified by maternal influence combined with marked heterosis and slight change in the corresponding matings in the back cross

Oxygen consumption during Yogic breathing exercises WALTER R MILES and K T BEHANAN Traditionally in the cult of Yoga special breathing routines have been used as a preliminary for mental concentration The exercise types in question range from those composed chiefly of extremely rapid shallow breathing (two respirations per second) to those involving extremely deep and slow ventilation (one respiration per minute) Some of the learned breathing patterns are characteristically continued for 20 to 30 minutes preceding concentration The present paper reports repeated metabolism experiments with three common Yogic patterns as practiced by a Hindu male (K T B) of 31 years following a two year period in the regimen of the Yoga cult Each breathing pattern is found to produce a considerable rise in metabolic rate during the time (10 to 30 minutes) of the exercise The effect on subsequent normal breathing appears to be transitory in two of the three types studied In the case of the Bastrika pattern where shallow and deep breathing are alternated within each minute the after effect is more definitely prolonged and is in the direction of a reduced metabolism A very slight increase in oxygen consumption is found in the experiments on mental concentration after normal quiet periods The study suggests that artificial breathing patterns, if they influence mental concentration, do so probably more in psychological than in physiological terms

Isolation from pancreas of a substance which inhibits trypsin digestion and its effect on the activation of trypsin JOHN H NORTHROP and M KUNITZ It has been known for nearly 100 years that the secretion from the pancreas possesses the property of digesting protein (meat) It has also been known that the secretion is inactive when it leaves the pancreas but becomes active upon entering the small intestine The agent (enzyme) responsible for this digestive power was named "trypsin" by Kuhne, but the chemical nature of this agent and the mechanism whereby it was activated have always been uncertain and controversial The writers have isolated from fresh pancreas the active and inactive form of two proteolytic enzymes, trypsin and chymo trypsin, and the activation of these pure compounds has been studied In addition, the writers have recently isolated a crystalline material which is a compound of the enzyme, trypsin and another substance (inhibitor) of histone like character which inactivates trypsin It was found possible to split the compound into trypsin and inhibitor, and both components were then obtained in crystalline form By combining the two components again the original compound may be synthesized and crystallized Crude inactive trypsin solutions containing a trace of active enzyme become active when allowed to stand in neutral concentrated salt (magnesium or ammonium sulfate) solution The purified crystalline inactive trypsin becomes active simply on standing in neutral solution without the addition of salt When purified inhibitor is added to purified inactive trypsin the mixture behaves like the crude solution and does not become active until salt is added The effect of salt upon the activation of crude inactive trypsin solutions, therefore, is to destroy the effect of the inhibitor The transformation of the inactive to the active form of the enzyme is caused by the active enzyme itself The experiment, therefore, represents the "propagation" of the active enzyme, since the addition of a small amount of active enzyme results in the production of a very large amount of "itself", just as inoculating a culture media with bacteria results in the production of many more bacteria The effect of the inhibitor is to inactivate the trypsin in the same way as an antiseptic would prevent multiplication of bacteria

Some aspects of anesthesia and irritability W J V OSTERHOUT and S E HILL. Cells of the fresh water plant *Nitella* respond to electrical stimulation like nerve

fibers but have the great advantage that each cell can be studied separately and is readily accessible to treatment with reagents The irritability of the cell depends on a substance, or group of substances, which we may for con venience call *R* This is shown by the fact that cells kept for 2 days in distilled water lose their irritability The water in which cells have been standing contains sub stances which, when suitably concentrated and applied to the cell, quickly restore irritability Such substances appear to be widely distributed, as might be expected in view of the general occurrence of irritability For ex ample, when irritability has been lost it can be restored in a few seconds by treatment with human blood If the substances causing this effect are responsible for the irritability of nerve and lead to disturbances in nervous functions when deficient, such substances must play an important part in ontogeny and in phylogeny as well as in pathology These experiments suggest that some anesthetics may produce their effects in the same way as distilled water, *i e*, by removing substances from the protoplasm What is said of irritability applies also in general to the potassium effect, *i e*, the large *P D* (about 85 mv) observed in leading off from a spot in contact with 0 01 *M* KCl to one in contact with 0 01 *M* NaCl. (In this respect the cell acts somewhat like a potassium electrode) The loss of this property is an additional indication of the profound change in the protoplasmic surface caused by dissolving out *R* What is the nature of *R*? One way of attacking this problem is to observe the effect of various pure substances. We find that the following can restore irritability or the potassium effect or both NH_3, NH_4Cl, tetra ethyl ammonium chloride, guanidine, adrenaline and ephedrine. In some cases only one effect was secured and when both were obtained one was usually restored before the other This indicates that they depend upon somewhat different conditions It would not be surprising to find that a variety of sub stances are effective We should expect that any sub stance capable of facilitating the breakdown of the non aqueous protoplasmic surface under an applied *E M F* would tend to restore irritability Any substance which decreased the mobility of the sodium ion as compared to that of the potassium ion (*e g*, by forming complex ions) or which increased the concentration of potassium ions (*e g*, by chemical reaction) would probably tend to restore the potassium effect.

What are resting states and active states in chromato phores, particularly melanophores? G H PARKER. In the past different investigators have expressed various views as to the resting state of Melanophores Some have declared that the state with dispersed pigment is a rest ing state, others that the state with concentrated pig ment is a resting one and still others that some inter mediate state is that of rest Experimental evidence shows that none of these views is correct Any state of inaction, irrespective of the position of the pigment, is a resting state as contrasted with one of pigment move ment which is an active state In this respect Melano phores are like smooth muscle fibers and unlike cross striped muscle-fibers The resting state of any Melanophore is ordinarily determined by its neuro-humoral environment.

Four theorems on the envelope of extremals MARSTON MORSE

Tauberian gap theorems NORBERT WIENER.

Analysis of 18,000 proper motions derived at the Leander McCormick Observatory P VAN DE KAMP and A N VYSSOTSKY

Observational evidence of an Einstein-red shift in Class O stars ROBERT J TRUMPLER. According to Einstein's Generalized Theory of Relativity the gravitational field of the sun or the stars causes a slight increase in the wave-lengths of lines observed in the spectra of these bodies The solar or stellar lines thus appear shifted toward the red as compared with similar lines of a labo ratory source of light This red shift is proportional to the mass of a star and inversely proportional to its diam eter For the sun it is small and difficult to verify, but in stars of small diameter or of large mass it becomes considerable Stars of spectral Class O, which are of the highest temperature and the greatest luminosity, are known to be the most massive, and these stars were there fore selected for a test of the red shift For stars in general the relativity shift of spectral lines can not be separated from the Doppler shift caused by their motion toward or away from the observer Fortunately, many stars of Class O occur in galactic star clusters Since the stars of such a cluster form a physical system, they must have nearly the same motion The latter can be obtained from observations of the fainter cluster stars, for which the red shift is small because of smaller lumi nosity, lower temperature and smaller mass The radial velocity observations of galactic star cluster which are in progress at the Lick Observatory are at present suffi ciently complete to allow such a test in six clusters The 9 Class O stars of great luminosity contained in these all show a decided positive excess of radial velocity for which there seems to be no other explanation but that of a relativity red shift Its average amount is 10 8 km/sec or 17 1 times the shift predicted for the sun An accurate numerical comparison with the theory is not pos sible because we do not know the masses of the individual stars, but if our interpretation of this effect is correct, we can use the observed red shift to determine the masses The average value of 180 times the sun's mass thus obtained is somewhat larger than the rather uncer tain value furnished by spectroscopic binaries The dif ference is perhaps due to the particular selection of our stars, but the observed red shift is at least of the right order of magnitude

Report on the progress of the Yale zone observations FRANK SCHLESINGER. Yale Observatory has now com pleted the reobservation by photography of five of the Astronomische Gesellschaft Zones, embracing the posi tions of 40,980 stars According to an agreement with the Astronomische Gesellschaft and with the Cape Obser

vatory in South Africa, arrangements have now been made for covering the whole sky in this way Yale's share in this work is the area between the equator and declination – 30°, and this is being done on fields of 110 square degrees with a Ross camera. These zones have shown a general improvement in accuracy until now the weight of a star position is double that in our first zone

Meningitis in man caused by a filterable virus THOMAS M RIVERS and T F MCNAIR SCOTT To be printed in SCIENCE.

New endocrine complexes from recombinations of old breed types C R STOCKARD

Significance of the amnion GEORGE L STREETER In early stages of primate embryos hitherto unavailable, it is found that the amnion is more closely related to the trophoblastic elements of the egg, in its origin, than to the cells that are to form the embryo proper Thus embryologically it is a transitional structure, serving only during fetal life and is to be grouped with the allantois, yolk sac and placenta In its development and later structure the amnion is essentially a serous membrane, functioning somewhat like the pleura and peritoneum Containing more fluid than these, it provides the growing fetus with ample freedom for movement

Relative importance of various genes to the organism M DEMEREC (introduced by A F Blakeslee) Present day genetics visualizes the appearance of an organism as a result of the interaction of the whole complex of genes possessed by the organism and the environment in which that organism develops Assuming that the environment is constant, the relative importance of the genes will be discussed here The whole complex of genes forms a balanced system which is sensitive to various changes occurring in that system The disbalance produced by such changes affects the organism and in many instances shows up as a new characteristic usually detrimental to the organism Studies with deficiencies, *viz*, the material in which certain genes are missing, indicate that not all genes are of equal importance in the life of an organism In the case of *Drosophila melanogaster* where chromosomes are paired and each gene therefore is represented twice, the following categories of genes have been recognized (1) If one gene of the two is missing it shows up as a detrimental characteristic on the organism, if both are missing the cell lethal effect is produced, *viz* even a small group of cells of such constitution is unable to live (Notch Minutes, Plexate) (2) If one gene is missing and the other is the wild type allel the organism is not visibly affected, but if the other gene is a mutant allel the character is exaggerated, deficiency for both genes is cell lethal (forked, tan, sable, tiny, rudimentary) (3) Deficiency for one gene has no effect on the organism deficiency for both is cell lethal (dusky, miniature, fused) (4) Deficiency for both genes is not cell lethal, but is lethal to the whole organism (cut, yellow, scute) (5) Presence of the gene is detrimental and its absence beneficial to the organism (Bar)

The mechanism of sexual reproduction in Neurospora and Gelasinospora B O DODGE. In normally bisexual races of *Neurospora* the ascogonium is quickly surrounded with a weft of sterile tissue Spermatization, or conidiation, is not necessary and no trichogynes are formed when the ascogonium is provided with nuclei of opposite sex reaction from the beginning There is no pause in the development of the ascocarp When unisexual mycelia are grown separately the same type of incipient perithecium is formed, but after it has reached a certain size trichogynous elements grow out through the sterile envelope No further growth occurs unless microspores or moniliold conidia of the other sex reaction come in contact with these receptive elements If this occurs fertilization follows and the ascocarp matures It will be shown that when unisexual races of opposite sex are grown together from opposite sides of a plate culture there is a more effective method of bringing the two kinds of nuclei together This feature also determines the perithecium distribution pattern so characteristic of many pairs of races *Gelasinospora tetrasperma* does not produce spermatia or other asexual reproductive bodies yet fertilization occurs readily in mixed cultures of facultatively heterothallic races The way this is brought about will be described

The genetic control of developmental relationships and its bearing on the theory of gene action E W SINNOTT (introduced by R A Harper) It has been shown that fruit shape in Cucurbita is controlled by a series of genetic factors and that these produce their effects independently of the size of the organ They evidently control relative rather than absolute growth When F_2 shape indices are plotted arithmetically they show marked positive skewness which disappears in logarithmic plotting, indicating that the genic effect is an exponential rather than an additive one Other dimensional relationships in the fruit behave similarly Widely diverse shape types can be derived graphically from a basic type by plotting it in a series of logarithmic coordinates of various sizes, and the series of fruit patterns thus seems to be the result of modifications of an axial exponential gradient A genic control of the steepness of this gradient would account for most of the shape differences observed Simple quantitative traits like fruit weight show a similar skewness in F_2 (though often not in environmental variability) and it may be that here, also, it is developmental relationships of various sorts, rather than absolute quantities which genes determine This is further suggested by the fact that size differences are found to be due to differences in the relative extent of various aspects of the developmental schedule, notably, cell division and cell enlargement It is suggested that in all inherited traits the relationships between rates rather than the absolute rates themselves are what genes control.

Old and new criteria for determining the relationships of higher plants WALTER T SWINGLE.

Analysis of rotatory dispersion curves of members of homologous series of the type $\mathrm{H{-}\overset{\displaystyle CH_3}{\underset{\displaystyle R}{C}}{-}(CH_2)_nX}$ P A LEVENE AND ALEXANDER ROTHEN In the above formula n = 0 or an integer, R = a normal alkyl or an aryl group, X = a functional group When n = 0, on substitution of X by Y, depending upon external conditions, one of two stereoisomeric substances may form Neither one's configuration can be determined by direct chemical means When n = 1 or an integer, then only one isomer can be formed, inasmuch as no inversion takes place during the reaction of substitution. Through the analysis of the rotatory dispersion curves it is possible to determine in each case the partial rotations of X and of the rest of the molecule In the case when n = an integer, it was found that on substitution of X by Y or Z, or some other atom or group, the change in rotation is independent of the value of n On the basis of the analysis of the events following the substitution of X by Y in this group of substances, it was attempted to predict the result of the reaction in the cases when n = 0

The oxygen equilibrium of hemoglobin and its structural interpretation LINUS PAULING It is shown that the data on the oxygen equilibrium of hemoglobin indicate that the four hemes of the molecule are arranged at the corners of a square, each heme is connected with two others in such a way as to give rise to an interaction energy of 1,500 cal/mole for each pair of adjacent oxyhemes, and each heme contains two acid groups the interaction energy of each with the oxyheme being 820 cal/mole It seems probable that the hemochromogens differ from hemoglobin mainly in that in the hemochromogens the hemes are independent and in hemoglobin four hemes form a conjugated system

Some physical properties of rubber prepared by fractionation and crystallization W HAROLD SMITH (introduced by W W Coblentz) A method of preparing pure rubber hydrocarbon from *Hevea latex* aims to preserve intact its physical structure The purified rubber is separated into two fractions by ethyl ether Approximately 75 per cent is soluble Each fraction yields crystals which differ in their melting behavior The stress strain characteristics of vulcanized fractions and x ray diffraction data indicate other differences The molecular weight of the soluble fraction is much greater than any value which has ever been reported for total rubber

Quadratic wave equation—flood waves in a channel with quadratic friction M A BIOT (introduced by C A Adams) A mathematical investigation is here made of what happens in a channel or a river in the case of the bursting of a dam When the retaining wall of a water reservoir suddenly gives way, a flood wave propagates in the channel with a constant speed The height of the wave varies all the time and decreases according to a certain law

Electrical communications, past, present and future FRANK B JEWETT

X ray wave lengths and the fundamental constants J A BEARDEN (introduced by R W Wood) The scale of x ray wave lengths has been obtained by three independent methods (1) A plane grating (ruled by Professor R W Wood) 75 mm long ruled with 100 lines per mm has been used in an ionization double crystal spectrometer to measure the wave length of the copper $K\alpha_1$ line These results are in good agreement with the author's 1931 photographic ruled grating measurements (2) X ray refraction measurements using a diamond prism have been made within an accuracy of 1 part in 10,000 and the x ray wave lengths obtained agree with the ruled grating results (3) Larsson has used a 5 meter concave grating to compare the high orders of the Al $K\alpha_{1,2}$ line with the first order of a known spark line These results are also in agreement with those of (1) and (2) Thus the absolute wave length of x ray lines is now known to within 1 part in 10 000 Since there is no evidence that would indicate the existence of a mosaic structure in crystals normally used for x ray work, and since many crystals have been found that fulfil the theoretical requirements of a perfect crystal one should be justified in using the absolute x ray data for calculating Avogadro's number N Such a calculation gives $N = 6.022 \times 10^{23}$ mol per mol Then by the use of the Faraday constant we can get the charge on the electron or $e = 4.803 \times 10^{-10}$ e s u This result is 0.75 per cent higher than is obtained from the oil drop experiment Planck's constant h as obtained from the high frequency limit of the continuous x ray spectrum is increased to $h = 6.608 \times 10^{-27}$ erg sec

Spectroscopic investigations in the extreme ultra violet K T COMPTON and J C BOYCE. The Carnegie Institution of Washington vacuum spectrograph, which is located in the spectroscopy laboratory of the Massachusetts Institute of Technology provides sufficient dispersion and resolving power, over a broad range, to make possible a considerable program of spectroscopic research in the extreme ultra violet The instrument has already been used on a number of investigations of emission spectra of atoms and of molecules and of absorption spectra of molecules, some of which have already been published Among the more recent and unpublished results of the group of workers collaborating in the use of this spectrograph are those which revise and extend the term analysis of argon, krypton and phosphorus In argon, de Bruin's term assignments for A II have been somewhat revised, additional triplet terms in A III have been discovered, and a start has been made on the doublet system in A IV

A model of atomic nuclei WILLIAM V HOUSTON

A new type of excitation function for nuclear reactions E O LAWRENCE, EDWIN McMILLAN and R. L. THORNTON The voltage excitation functions for the

reactions in which radioactive Na^{24} and Al^{28} are formed from sodium and aluminum by deuteron bombardment have been investigated up to a deuteron energy of 3 3 Mv These results show a type of behavior quite different from that to be expected on the basis of the Gamow theory of nuclear penetration The differential excitation curves, plotted against the deuteron range, start to rise appreciably at about 1 0 Mv, build up exponentially to about 1 8 Mv,[1] and then become linear and remain so to the highest energy of 3 3 Mv A sharp contrast thus exists between the experimental results and Gamow's formula, since the latter predicts a rapidly increasing slope over the whole energy range It was also found that deuteron bombardment caused radioactivity in copper, an element of surprisingly high atomic number for such an effect The radioactive product has a half life of 6 hours and is presumably the copper isotope also formed by neutron bombardment The excitation curve in this case starts at 1 5 Mv, and is still increasing in slope at 2 8 Mv, but not nearly as rapidly as predicted by the Gamow theory A theoretical interpretation of these results has now been found by J R Oppenheimer[2] The reactions mentioned above are all of the type in which a deuteron gives up its neutron to a nucleus If this involves the entry of the whole deuteron into the nucleus, the Gamow theory should hold, but a process is also possible in which, while the deuteron is just outside a nucleus, the neutron leaks through the potential barrier separating its normal state in the deuteron from a bound state in the nucleus This barrier is in general much more penetrable than that opposing the entry of the whole deuteron The numerical consequences of this theoretical picture have been worked out by Professor Oppenheimer and Dr M Phillips for the cases described above The form of the resulting curves depends on the value assumed for the binding energy of the neutron. An extremely good fit with the experimental curves in all three cases is given by his formula with the binding energy taken as 1 7 Mv, values differing from this by 0 9 Mv give curves in gross disagreement with the experimental results It thus appears that the present results and their theoretical interpretation offer a new method of evaluating the binding energy of the deuteron and hence the mass of the neutron The values thus obtained are very near to those now accepted

Further experiments on the cosmic ray longitude effect ROBERT A MILLIKAN and H VICTOR NEHER

Exact solutions of wave diffraction and scattering problems in elliptic and spheroidal coordinates PHILIP M MORSE (introduced by John C Slater) The solutions of the wave equation in spheroidal and elliptic cylinder coordinates, discussed by Stratton in the preceding paper, have been computed, in part by the differential analyzer, and tabulated These tables, together with the addition formulae expressing the plane wave in terms of the spheroidal functions (see Morse, *Proc Nat Acad*, 21 56, 1935) make it possible to obtain exact solutions of a large number of diffraction and scattering problems As an example of the method, the scattering of a plane wave by a long, perfectly reflecting ribbon of width d and the diffraction of a plane wave by a slit of width d have been computed for a range of wave lengths of the order of magnitude of d, for different angles of incidence and for different boundary conditions The problems are related by Babinet's theorem. The resulting curves evidence interesting resonance effects when the wave length equals d or 2d The results of the scattering problem are useful in a study of the acoustical properties of ribbon microphones and loud speakers Other problems which can be solved exactly by the use of the tables are the scattering of waves (sound, light or electron) by prolate spheroids or by round disks, the radiation of waves from these objects and the diffraction of waves by circular apertures

On the fundamental equations of elasticity, with special reference to the behavior of solids and liquids under extreme pressures F D MURNAGHAN (introduced by Joseph S Ames) Formulae are derived for the components of the stress tensor in terms of the energy of deformation and its derivatives with respect to the components of the strain tensor (the latter being referred to the strained position of the medium), without making the usual assumption that the deformation is infinitesimal As a special result it turns out that for media under uniform (hydrostatic) pressure p is a function of the quantity $e = \left(\frac{V_0}{V}\right)^{2/3} - 1$ On testing the cubic expression $p = ae + be^2 + ce^3$ on recent experimental results of Bridgman on lithium, sodium and potassium with a pressure range of 2,000 to 20,000 atmospheres (the constants a, b, c being determined by the values at 2,000, 10,000 and 20,000 atmospheres) the theoretical formula agrees, over the entire range, with the experimental results to within one half of 1 per cent For liquids (n amyl iodide and n butyl iodide) over a range of 500 to 12,000 atmospheres there was agreement to within 2 per cent (all but four out of some fifty calculated values being within 1 per cent of the observed values) The values of the constants for the solids were *Lithium* $a = 179\ 11 \times 10^3$, $b = 140\ 0 \times 10^3$, $c = 145 \times 10^4$, *Sodium* $a = 94\ 13 \times 10^3$, $b = 251\ 8 \times 10^3$, $c = 47 \times 10^3$, *Potassium*: $a = 44\ 81 \times 10^3$, $b = 124\ 72 \times 10^3$, $c = 142\ 5 \times 10^3$

The width of spectrum lines F K RICHTMYER and E RAMBERG According to classical theory the observed width of spectrum lines depends on (1) the Doppler effect due to the thermal motion of the emitting atoms; (2) interruptions of the vibrating mechanisms by collisions with other atoms, and (3) radiation damping, the greater the damping the wider the line In the optical

[1] These curves had been examined previously to 1 9 Mv (E O Lawrence, *Phys Rev*, 47 17, 1935, E M McMillan and E O Lawrence, *Phys Rev*, 47 343, 1935) In this voltage range the observed deviation from the Gamow formula was so slight that it was not considered significant at that time

[2] We are much indebted to Professor Oppenheimer for his valuable cooperation in this work

region (3) is very small compared to (1) and (2) In the x ray region (1) and (2) are negligible compared to (3), which is large enough to permit measurements of widths Such measurements, however, show that x ray lines are, in general, much wider than would be expected from (3) This is explained on the quantum theory as follows In the quantum theory, radiation damping is replaced by "mean life" of the atom in a given excited state, the shorter the mean life, the greater the effective width of the state The mean life is determined not only by the radiation transitions between states (corresponding to radiation damping) but by the probability of radiationless transitions (Auger effects) Quantum mechanical calculations show that the widths of a large number of the excited states, and hence of the spectrum lines resulting from transitions between states, are due in large part to Auger effects There is qualitative agreement between the computed and the observed widths

Intensities of x ray satellites ANNA W PEARSALL (introduced by F K Richtmyer) After a brief survey of the bearing of the problem of the intensities of x ray satellites on the origin of x ray spectra, a résumé is given of previous measurements of satellite intensities, particularly those associated with the L-series spectral lines The present paper reports measurements on the intensities of the satellites accompanying the strong K series lines, $K\alpha_1$ and $K\alpha_2$ These data are the more important because of the recently published theory of Coster and Kronig (*Physica* II, 13, 1935) concerning the relation of the Auger effect to the origin of satellites Since the type of Auger effect discussed by Coster and Kronig can play no part in the origin of K satellites, it might be expected that the variation of their intensities with atomic number would obey a very different law from that applicable in the case of L satellites Using a Siegbahn vacuum spectrograph, spectrum plates were made of the $K\alpha$ lines with accompanying satellites $K\alpha_{3,4}$ for elements in the atomic number range S(16) to Cu(29) inclusive From microphotometric records of these plates, intensities of $K\alpha_{3,4}$ relative to $K\alpha_1$ were obtained These intensities vary from 0 7 per cent for Cu(29) to some 3 per cent or 4 per cent for Cl(17) and K(19) No sharp maximum of intensity similar to that found with the L satellites was observed

The ancestral tree of the Proboscidea Discovery, evolution, migration and extinction over a 50,000,000 year period HENRY FAIRFIELD OSBORN Ancestral Titanothere tree embraces 15 phyla extending over 20,000,000 years, Lower Eocene to Lower Oligocene, exhibits independent origin and evolution of bony horns, independently arising as "aristogenes" Proboscidea exhibit 30 independent lines of descent, extending over period of 50,000,000 years, superior tusks take the place of horns In contrast to arrested evolution of titanothere grinding teeth, Proboscidea exhibit 30 distinct lines of evolution in the grinding teeth coordinated with special adaptations of either superior or inferior tusks, adapted to variations of herbivorous diet ranging from arctic to equatorial conditions in all continents except Australia Aristogenesis can now be measured as to secular rate of evolution. It is in widest possible contrast with the D mutations Aristogenesis in the origin of the cones of the grinding teeth is in accord with 18 principles namely Every single aristogene obeys the eighteen principles of biomechanical adaptation, it has its own individual and particulate adaptive history it is coordinated with the functions and adaptations of the organism as a whole its survival and relative strength or its reduction and elimination is determined by its degrees of service Evolution of proportion (Alloiometrons) is in contrast with Aristogenesis and follows two principles namely (1) Irrespective of remote ancestry and remote phylogenetic affin ty, closely similar adaj t ve changes of proportion in the cranium and in the segments of the limbs arise in different lines of mammalian and reptilian descent (2) Convergent alloiometrons in the limbs, cranium and grinding teeth arise as relatively rapid secular changes following adaptive radiation in habit and function They are most strongly convergent where there are the most intense similarities in the geographic and geologic environment Alloiometrons are extremely rapid and entirely independent of ancestral hereditary influence, that is, similar changes of proportion may occur in the limbs of dinosaurs and of mammals Aristogenes (*e g*, horns of titanotheres dental cones of proboscideans) are absolutely dependent upon ancestral heredity and arise only in long periods of geologic time The author's thirty four year research on the evolution of Titanotheres and Proboscidea yield all the known modes and principles of the origin of species as defined by biomechanical characters

The change in the range of accommodation with age and its connection with the length of life FELIX BERNSTEIN (introduced by Franz Boas) A systematic study of the inheritance of the duration of life is difficult because death is due to accidental as well as to natural causes Therefore, I tried to substitute the study of the heredity of the span of life by the study of the physiological aging of the organs of the body The easiest measurement in that respect is that of the change in the elasticity of the lens of the human eye manifested in the loss of the power of refraction with age which becomes apparent as a defect during middle age (presbyopia) Data on 5,000 cases of presbyopia gathered from the university clinics of Goettingen and Leipzig and from two private oculists, and followed individually from the first tests until death, proved that presbyopia is correlated with the duration of life in such a way that the early presbyopes die early and the late presbyopes die late This whole correlation applied only to those who died from brainstroke and heartstroke, constituting about half of the material The other half, who died of pneumonia, diabetes, cancer and other diseases, were not at all or only slightly correlated By classifying the data in three classes, normal, sub normal and super normal presbyopia, we found, for instance, that the expectation of life length in the three classes at

the age of 50 amounted to more than eleven years difference between the highest and lowest class of those who died of arteriosclerosis During the summer and fall of 1933, family data on the range of accommodation have been collected with the aid of a grant from the Rockefeller Foundation given to the Biological Laboratory at Cold Spring Harbor In order to compare the data of different ages, all persons were reduced to a normal age taking in account the development of the range of accommodation as determined by the whole material We compared the standard deviation of the range of accommodation among the members of the same family from the family mean with the standard deviation of all individuals from the mean of the whole material The average square of the deviation from the general mean was 9 97, on the other hand, the average square of the deviation from the family mean was only 3 58 This shows conclusively that the physiological aging measured by the range of accommodation is essentially hereditary In the year 1934–35 the data of 95 families were collected in Jersey City, N J From these the square of the standard deviation of the members of the family from the family mean amounted to 2 9 the square of the standard deviation of the whole population from the general mean amounted to 8 7 This result confirms the previous conclusions The investigations do not indicate any sexual difference in regard to the range of accommodation The fact that women actually live one year longer on the average than men, therefore, is not due to hereditary causes but is due to the differences in the conditions of life in both sexes These implications of natural span of life are especially important in regard to the fact that the natural causes of death come more in the foreground the more the infectious diseases are brought under control

The tempo of growth of fraternities FRANZ BOAS Previous investigation has shown that the tempo of development from six years to adult life must be considered as a unit so that children who at six years are developing rapidly will continue to do so and reach adult life more quickly than those who at six years are retarded A study of the growth curves of brothers and sisters of rapidly developing children shows that these also will develop rapidly and that the brothers and sisters of those retarded will develop slowly The tempo of development must therefore be considered as in part determined by heredity At the same time the influence of environment must be recognized The average dates of maturity of Hebrew and Northwest European girls, both in private schools and in orphan asylums, are practically the same, namely, 12 years and 5 months, while Negro girls in orphan asylums, on the average, mature 6 months earlier The influence of environment upon bodily form is also expressed in a comparison between the statures of immigrants and their descendants It is well known that stature in Europe has been constantly increasing The stature of immigrants, on the other hand, between 1860 and 1920 has remained constant, while the stature of their American born children has been constantly increasing In 1910 I showed that the cephalic index of immigrant Hebrews was on the average 83 0, that of their descendants born in the United States 81 4 Children of Hebrew mothers born in the United States had an index of 79 7 At that time families in which both parents were native born were difficult to find Measurements made by Dr Nicolai Michelson during this winter gave an index for children of native born Hebrews of 78 7

The neural basis of memory in primates C F JACOBSEN (introduced by Robert M Yerkes) Two basic types of modification of behavior through experience have been distinguished (1) Modification of response which does not suggest any change in the innate connections between receptor and effector mechanisms (progression of physiological states), and (2) modification which implies a change in the pattern of connections between receptors and effectors (associative memory, conditioned reflexes) The latter kind has been regarded as the type of all true learning and efforts have been made to describe complex behavior as combinations of simple associations According to this view the concept of learning and memory embraces a unitary process However, distinctions have been made between various forms of memory—motor habits, associative memory, conditioned reflexes, logical memory and reproductive memory or recall These distinctions rest largely upon differences in the stimulus response relations involved, and it has often been assumed that the variety of phenomena resulted from different methods of study But this array of phenomena justifies raising the question whether the concept of memory can be studied as a unitary process or whether it comprehends phenomena having no common organic basis In this paper evidence will be presented that memory embraces qualitatively different phenomena mediated by different neurological mechanisms In the investigation of the neural basis of memory, monkeys and chimpanzees were tested on a battery of behavioral problems, subjected to surgical lesions of the cerebral cortex, and examined for deficits in the abilities measured before operation. The tests ranged from simple conditioned reflex situations to complex "insight" problems, and included tests of instrumentation, delayed response, sensory motor habits and visual discrimination Complete bilateral extirpation of the frontal association areas caused failure on those problems which required some capacity for reproductive memory Injury to the frontal areas not only caused amnesia for previous acquisitions of this kind, but produced a permanent loss as evidenced by failure to improve with extensive reeducation On the other hand, the subjects which exhibited profound deterioration of reproductive memory suffered no amnesia for discrimination habits and problem box solutions and showed no retardation in the acquisition of new habits of a similar nature Control observations indicate that this impairment of recall can not be attributed merely to an extensive injury to the cortex, since lesions in the temporal, parietal and motor regions caused no deterioration of this function. Lesions of the frontal cortex cause not general weakening of memory but only

deterioration of a special form of memory It thus seems that the various phenomena of learning and memory can not be regarded merely as different aspects of an essentially unitary process On the contrary, the concept of learning and memory is seen to comprehend at least two, and probably more, diverse processes which are mediated by different neurological mechanisms

A habitation site and workshop attributable to so called Folsom Man FRANK H H ROBERTS, JR. (introduced by John R. Swanton) A significant addition to the material illustrating an early phase of aboriginal American culture was obtained during October and November, 1934, in northern Colorado, where indications of a camp site and workshop attributable to so-called Folsom Man were brought to light A whole series of stone implements—several types of scrapers, a variety of cutting edges, drills, engraving tools—and numerous examples of the characteristic point identified by the name Folsom were found in situ in a dark layer of earth 14 feet below the present ground level The layer, which was exposed in the side of a deep and narrow gully, also contained quantities of cut and broken animal bones, stone chips and flakes resulting from the manufacture of tools, charcoal and ashes, and other refuse such as accumulates around habitations The concentration undoubtedly was a midden, and remains of dwellings probably are nearby Whereas the only traces of a presumably early hunting people prior to this find were typical finely chipped points of stone, there is now a definite complex of associated implements In addition the scrap flakes give evidence of the technique employed in the manufacture of implements, and the spalls and nodules indicate that the stone-working was done on the spot Raw material suitable for making tools is plentiful in the neighborhood The points which became the pattern for the type were found by a party from the Colorado Museum of Natural History in 1927 near the small town of Folsom, New Mexico, hence the name They were in association with skeletons of an extinct species of bison, one which is considered as having lived at the close of the glacial period Since then other points of that type have been found at different localities along with bones of another extinct species of bison, of an unidentified musk ox like creature, and of the mammoth The supposition that the type represents considerable antiquity rests upon these associations Whether the finds actually date man in North America at the beginning of the post glacial period or demonstrate a later survival of Pleistocene animals is a phase of the problem which the geologist and paleontologist must solve Archeologists generally concede that the Folsom points belong to the earliest phase of aboriginal American culture yet discovered The main importance of the Colorado find lies in the fact that for the first time a variety of implements has been obtained for that horizon. The site was originally discovered by Judge C C Coffin and his son, A L Coffin It was brought to the attention of the Smithsonian Institution by Major Roy G Coffin, of Colorado State College, Ft. Collins

Event classifications in Navaho, a study in linguistic psychology E SAPIR. Any "event" may, for purposes of linguistic reference, be classified from various points of view A number of such points of view, applying to the Navaho verb, are briefly summarized in this paper The complex formal system of the Navaho verb can be functionally analyzed from five points of view 1 voice, 2, person (including number), 3 state ("neuter" and "active"), 4, tense mode, and 5, aspect (*e g*, momentaneous, continuative, repetitive) In many ways these Navaho classifications come closer to a freshly objective view of the nature of events than do those of such languages as English or Latin.

Some reactions of Mongolians and Caucasians in an emotional situation G M STRATTON and FRANKLIN M HENRY Chinese and Japanese together with Americans of the Caucasian race—about fifty persons of each of these three kinds about 150 persons in all—were placed singly in a laboratory situation aimed to be at least mildly stirring And the conditions were such that the slight stir of emotion might not have an obviously different association with the different ancestral cultures involved It, however, is not claimed that the influence of racial culture has been completely excluded A large and heavy wooden hammer, about six feet long and mechanically controlled, was watched by the subject as it fell from a considerable height and struck a resounding blow close to his outstretched hand There were instrumental records of the involuntary movement of the hand, together with records of changes in the breathing, pulse rate, blood pressure and the electrical resistance of the skin The present report is concerned only with the movement of the hand In this both the Chinese subjects and the Japanese subjects, in the average of their reactions, appear to be significantly different from the Caucasian subjects, giving smaller reactions than do the Caucasians, while the Chinese subjects and the Japanese do not, on the whole, seem significantly different from each other

Biographical memoir of Edward Sylvester Morse L O HOWARD

Biographical memoir of George Perkins Merrill WALDEMAR LINDGREN

Biographical memoir of Edward Wight Washburn W A NOYES

Second report on the physical studies of the members of the National Academy ALEŠ HRDLIČKA Final report on the speaker's measurements and observations on 150 members of the National Academy, 100 of which were old Americans (all members of whose families were American born for at least three generations), 50 European born or of more recent American derivation The studies were complicated by the somewhat small numbers of the subjects and the advanced age of many of the members, nevertheless a number of interesting points came out quite clearly The outstanding results are as follows (1) The two classes of members showed unexpected general similarity, differing only in certain few characters (cephalic index, some facial dimensions, etc) (2) The membership as a whole rep-

resents in every respect a remarkably normal group, above the average of the general population (3) The members in whom the body proportions have not yet suffered notably from senility, in both groups show tall stature, higher than even that of the old Americans at large (4) The head in the academicians, both groups again, is both absolutely and relatively to stature distinctly larger than that in the general American population, and the increase is especially in the breadth of the head, which raises somewhat the cephalic index (5) All the facial features, particularly in the old American members, tend towards reduction. (6) The chest in the members of both groups is spacious and especially deep (7) In pigmentation the members of the academy show absence of pronounced blonds, absence of marked reds and frequency of dark hair (though now mostly gray) The total of the results indicates that barring rare exceptions, the membership of the academy represents not only mentally but also physically a select group

(*To be continued*)

OBITUARY

DAVID GRIFFITHS

BORN at Aberystwith, Wales, on August 16, 1867, son of David and Rachel (Lewis) Griffiths, he died at Emergency Hospital, in Washington, D C, on March 19, 1935

He came to the United States with the family when about three years of age, settling on a farm in South Dakota, his early education being in the local schools, including Groton S Dak, Academy and Aberdeen, S Dak, High School Having taken a general scientific course, majoring in botany, he was graduated from the South Dakota Agricultural College in 1892, receiving his M S in 1893 During his attendance in college he taught school in winters, and from 1893 to 1898 taught biology physics and chemistry in the Aberdeen, S Dak, High School Specializing in botany and zoology at Columbia University he received his Ph D in 1900 At this time he was interested in the study of fungi, publishing contributions on powdery mildews, smuts ergots and others in *Asa Gray Bulletin*, *Torrey Botanical Club Bulletin* and elsewhere

He was professor of botany and botanist of the Experiment Station of the University of Arizona in 1900–01, there beginning the studies of grasses and other range plants and range management which continued through the first fifteen years of his service in the Federal Bureau of Plant Industry, which he entered in 1901 as expert in charge of field management in the Office of Grass and Forage Plant Investigations This work involved extensive travel and field studies of native pasture grasses, salt bushes and cacti, from the Canadian border southward well into Mexico These studies resulted in numerous department publications in which, along with other conclusions of scientific interest and practical importance, the imperative necessity for avoidance of overstocking the ranges with resultant depletion of plant cover and destructive erosion was emphasized In these studies he became impressed with the economic importance of the cacti as forage plants, and through utilization of native stands and experimental plantings in Texas and California established the usefulness of some of these as emergency forage reserves to tide over drouth shortages His published results of experiments with "spineless" prickly pear constituted the most important stabilizing factor during the extravagantly optimistic exploitation of this plant which occurred during the first decade of the present century and served effectively to warn the public against the indiscriminate extensive planting of the spineless forms in climates to which they are not adapted because of their susceptibility to injury by cold

Appreciating the possibilities of cacti as ornamental plants, he early assembled a comprehensive collection of species and varieties at the Plant Introduction Garden at Chico, Calif, which afforded material for the preparation of a fine collection of colored illustrations, unfortunately as yet unpublished Close to 3,500 numbers of Opuntia were included in the Chico collection From these experimental studies of the cacti resulted a steady flow of papers on taxonomic, agronomic and horticultural phases published by the Department of Agriculture, the Missouri Botanical Garden, with which close cooperation existed, and in various scientific and popular journals from 1905 to about 1920 These materially enlarged available knowledge of cacti and were of particular importance because of their timeliness in relation to the development of the wide-spread and intensive interest in them as agricultural and horticultural plants

His steadily increasing interest in the horticultural field resulted in his eventual assignment to the bulb production project of the Bureau of Plant Industry, to which approximately his last twenty years were devoted Some preliminary experimentation in the commercial production of Dutch bulbs, in distinction from the flowering of the imported bulbs both out of doors and under glass, had previously been done, with results which indicated probability of developing satisfactory production of some species Economic conditions differed so widely from those in the European countries from which the imported supply came, and the lack of training and experience in the art of bulb growing

among American growers was so obvious that the pioneering of the industry along lines technically efficient and economically sound was a difficult undertaking Though the funds available were woefully inadequate for the purpose, Dr Griffiths entered the field with such enthusiasm of spirit and tenacity of purpose, and so promptly devised scientifically sound and practical methods of procedure that he soon became recognized as the unquestioned leader in this field Maintaining experimental plots and to some extent variety collections at Arlington Farm, Va, Bellingham, Wash, Willard, N C, and cooperative tests with interested amateurs and commercial growers in many sections, his leadership was largely responsible for the progress thus far made in commercial bulb production in the United States

Even as senior horticulturist much of his field work was of necessity done with his own hands, frequently under weather and soil conditions which involved physical hardship and hazard to health which would have discouraged one less resolutely persistent and determined to carry through the undertaking His sustained enthusiasm and courage under such conditions inspired loyalty in his assistants and encouraged them to do their very best

Dr Griffiths' most extensive and immediately important bulb work from the economic standpoint dealt with the devising of practical methods of growing and handling the bulbs of narcissi, tulip, hyacinth, as well as Easter, Madonna, Henry, Speciosum and Tiger lilies and other already widely grown and extensively imported Dutch bulbs, upon most of which he published extensively and usefully through the Department of Agriculture He was at the same time intensively interested in the newer and less well known bulbous plants, notably the Regal, Nankeen and other foreign lilies, and especially in such potentially important lilies as the Leopard, Lemon, Humboldt, Columbia, Martagon, Turk's-cap, Canada and other native species He worked out and published practical methods of propagation of these and many other bulbous plants Determination of the economic value of the American grown bulbs in contrast with the imported product necessitated intensive experimentation in their curing, transporting and storing, and especially the effects of storage temperatures upon their reaction to the forcing house conditions under which they are extensively utilized by florists He had much hybridization of bulbous plants under way, particularly lilies and daffodils and had named and described a considerable number of promising new varieties, some of which are in process of dissemination

His technical articles on bulb subjects which comprise many papers in the proceedings of scientific societies and bulletins of the department, were effectively supplemented by a steady flow of less formal articles addressed mainly to a rapidly increasing audience of actual and potential bulb growers who could best be reached through such representative horticultural trade periodicals as *Florists' Exchange, Florists' Review, Seed World,* etc, in which more than one hundred articles were published His crisp and lucid style of presentation added greatly to the practical value of these communications, for he possessed in marked degree that informal clarity of expression which while sometimes vexatious to editors is the joy and satisfaction of the lay reader

Reared, and in the main schooled close to the agricultural frontier of that time Dr Griffiths developed a rare combination of scientific accuracy in his research and sound common sense in the practical application of his discoveries Indefatigably industrious and efficient, the work which progressively he undertook on fungi, grasses, cacti and bulbs he put his whole soul into

Dr Griffiths married Miss Emigene Lily in 1905, who died in 1909 A daughter, Mrs Elizabeth Griffiths Lash, and a son, John D Griffiths, survive, together with his widow, Mrs Louise Hayward Griffiths, a sister and a brother

WM A TAYLOR

BUREAU OF PLANT INDUSTRY

SCIENTIFIC EVENTS

PROTECTING WILD LIFE

THE possibility of new conventions for the preservation of wild life in various parts of the world was referred to by Sir P Chalmers Mitchell, secretary of the Zoological Society of London, when presiding on April 15 at a general meeting of the Society for the Preservation of the Fauna of the Empire Dr Mitchell stated, according to the London *Times*, that

since the last meeting the most important event, so far as they were concerned, was the final ratification by the British Government of the African Convention. They had been waiting a long time for it, but the British Government had had to consult a large number of provincial governments in Africa and other parts of the world. Now that the British Government had ratified the convention there was no doubt that the other governments whose delegates had signed would also ratify it. It was the first and a very important stage in preserving the flora and fauna of the Continent of Africa. They hoped that the convention would serve as a model for similar conventions which would gradually embrace a large part of the world There had been an All India conference

and the chief business was to see how far it was possible to adhere, so far as India was concerned, to the African Convention. They had reason to hope that the All India conference would prove to be a direct step towards a conference to deal with a large part of Asia and Australasia

One of the greatest troubles that had existed in Africa for a long time had been a plague of locusts A new method of dealing with it by the use of aeroplanes had been adopted and a powder fatal to locusts and containing arsenic in some form had been used It was very effective, but it also either directly or indirectly killed a large number of other kinds of animal life They had been considering the matter and collecting all the information they could about it and there was some hope now of getting a preparation which while destructive to locusts, would not do damage to other forms of life

The executive committee of the society reported that the fate of seals both on the southwest coasts of Britain and also in the waters of Newfoundland and Labrador continued to exercise their attention Regarding Cornish seals they were now consulting various authorities of scientific note and were endeavoring to arrive at an unbiased view of the situation before deciding on any definite representations in official quarters

A STUDY OF AIR POLLUTION IN NEW YORK CITY

A SURVEY of air pollution which it is hoped will provide the basis for purer air and more sunshine in Greater New York will be undertaken as a Works Division project of the Emergency Relief Bureau under the auspices of the Department of Health, according to an announcement made by Oswald W Knauth chairman and executive director of the bureau

With the cooperation of Health Commissioner John L Rice, combustion engineers, chemists and bacteriologists will take part in the work. The plan also calls for inspectors, many of whom will be engineers, who will be assigned throughout the city to watch for undue smoke from factory chimneys, apartment house incinerators, automobile exhausts steamboat funnels and other sources of air pollution Offending equipment will be investigated to determine the cause of the faulty combustion and each case of air pollution whether by smoke, gas, fume, or by dust and dirt, will be reported to the Department of Health for action The engineers will also explain how defects can be remedied and will supplement this service with an educational campaign among building owners and others, both by personal interview and by the distribution of printed technical information.

Five observation posts will be established on high buildings in the more congested districts, where hourly examinations will be made throughout the day for comparison with the Riegelmann chart, which gives a standard of comparison generally accepted in studies of this type Dust caps will be placed at strategic points throughout the five boroughs and the accumulations in these will be analyzed, both quantitatively and qualitatively, by chemists at regular intervals for bacteriological content.

Observation posts are also to be established at Jones Beach and in Westchester to make similar readings and analyses for purpose of comparison

SIGMA XI LECTURES

DR KARL LASHLEY professor of psychology at the University of Chicago, who recently accepted a call to Harvard University, delivered the Sigma Xi annual circuit lecture at the Kansas State College and at the Universities of Kansas and Missouri, giving in each case the annual initiation address His subject was "Functional Reorganization after Brain Injuries"

Dr Harlan T Stetson, visiting professor at the Institute of Geographical Exploration Harvard University, addressed the Brown University chapter on April 16 on "Earth Moon Relations"

Professor R A Wardle, of the University of Manitoba, on April 11 addressed the chapter at the Iowa State College on 'Zoological Problems of the Canadian West"

The annual dinner of the Rensselaer Chapter was held at the Rensselaer Polytechnic Institute on April 26 Dr Edgar Allen, of Yale University, spoke on "The Endocrine Control of Reproduction"

Professor Robert H Baker, of the Observatory of the University of Illinois, gave two lectures on April 16 and 17 under the auspices of the Ohio University Club on "The Present Great Problems of Astronomy" and "Beyond the Milky Way"

DETENTION OF PROFESSOR KAPITZA IN RUSSIA

PROFESSOR PETER KAPITZA, who has been conducting researches in the Mond Laboratory at the University of Cambridge, has been detained in Russia where he went to attend a conference in honor of Mendeleef When he was preparing to return to Great Britain he was told that the government would not renew his passport as his services were needed as director of a new Institute of Physical Research under the Academy of Sciences at Leningrad.

In a long letter to the London *Times*, fully reported by wireless to *The New York Times*, Lord Rutherford says that Professor Kapitza after twelve years of work was on the eve of completing experiments expected to throw new light on the properties of matter in intense magnetic fields at the lowest possible temperatures. He further writes

Professor Kapitza, although he long resided in England, remained a Soviet citizen and a loyal one, who regu

larly visited Russia By the distinction of his work in England, which added materially to the already high reputation of Russian science, he was influential in promoting happy scientific relations between Russia and Britain and obtaining for his scientific compatriots a cordial welcome in English laboratories

While nobody disputes that the Soviet has a legal claim upon Professor Kapitza s services, its sudden action in commandeering them without any previous warning has profoundly disturbed the university and the scientific world Professor Kapitza was not even allowed to return to Britain to discuss with the university and the Royal Society [which contributed a large sum to his experiments] arrangements for carrying on the work of the laboratory of which Professor Kapitza is director It requires no imagination to realize how painful Professor Kapitza s own position is

Lord Rutherford then asserts that science is international and that the facilities granted to Professor Kapitza in England are a good example of that fact He concludes

May we hope that the Soviet, which has given so many proofs of its interest in the development of science will pursue a generous and long sighted policy and see its way to meet the wishes of scientific men throughout the world by enabling Professor Kapitza to choose the environment in which he can most effectively utilize the special creative gifts with which he is endowed? It would be a tragedy if these gifts were rendered sterile by failure to grasp the psychological situation

IN HONOR OF DR WILLIAM ALBERT NOYES

DR WILLIAM ALBERT NOYES, emeritus director of the chemical laboratories of the University of Illinois, has been awarded the fifth Priestley Medal, established in honor of Joseph Priestley, the discoverer of oxygen, which is bestowed every three years 'for distinguished service to chemistry" by the American Chemical Society

The first Priestley award was conferred on the late Ira Remsen, professor of chemistry and president of the Johns Hopkins University, the second on the late Edgar F Smith, professor of chemistry and provost of the University of Pennsylvania, the third on Francis P Garvan, president of the Chemical Foundation, and the fourth on Dr Charles L Parsons secretary of the American Chemical Society

Dr Noyes, who is now seventy-eight years old, began his active career in chemistry as professor at the University of Tennessee from 1883 to 1886 Following that he was a member of the faculty at Rose Polytechnic Institute until 1903

He served as the first chief chemist of the National Bureau of Standards in Washington from 1903 to 1907, in which year be became director of the laboratories in the University of Illinois, retaining that post until his retirement in 1926 As director emeritus, he has continued his active work in scientific research in the widely varied fields of organic inorganic and physical chemistry, particularly in the field of electronic theories

Dr Noyes was secretary of the American Chemical Society from 1902 to 1907, and president in 1920 He edited the *Journal* of the American Chemical Society from 1907 to 1917 and established *Chemical Abstracts*, first issued by the society in 1907, himself editing the publication for two years He has been the editor of the Scientific Monograph Series of the society since its beginning in 1909

Dr Noyes is a member of the National Academy of Sciences, of the American Philosophical Society, of the American Academy of Arts and Sciences and of many other scientific organizations He received the degree of doctor of philosophy from the Johns Hopkins University and holds honorary degrees from Clark University, the University of Pittsburgh and Grinnell College

The award will be presented at the ninetieth meeting of the society to be held in San Francisco next August Members of the Committee on Awards in pure chemistry are Professor Edward Bartow, of the Iowa State University, president elect of the society, Professor Homer B Adkins, Dr John Johnston, Dr Ralph E Gibson, Dean Frank C Whitmore, Dr W H Carothers, and Edward Mack, Jr

LETTER OF WELCOME FROM THE PRESIDENT OF THE UNITED STATES TO THE NATIONAL ACADEMY OF SCIENCES

AT the opening of the first general session of the National Academy of Sciences on April 22, the president of the academy, Dr W W Campbell, read the following letter, addressed to him from the White House, by President Roosevelt

As you and your eminent colleagues meet in the seventy first annual assembly of the National Academy of Sciences, I bid you warm welcome to Washington, and express my cordial wish for the greater development and usefulness of the academy

The country has every reason to be proud of the record of its scientific men and engineers In astronomy, medicine, physics, chemistry, geology and other sciences, and in the progress of engineering in all its branches, the contributions of America have been and still are outstanding in a friendly world rivalry

It is a matter for thankfulness that among the many sources of world distrust and jealousies, science preserves an ideal of purity, truthfulness and mutual good will toward all nations Not only do cooperative international scientific projects flourish, but the publications of scientists are received at face value in all lands, even though they be politically at variance

The National Academy's charter provides that the

academy shall be ready at all times to give advice when called upon by any branch of government This privilege has been availed of by government on many occasions One of the most notable was during the Great War, when the National Research Council was established by the academy at President Wilson's call to mobilize the scientific learning and ability of the country to aid in that great struggle

I take this opportunity to thank the academy for the advice and assistance it has given the administration during the past two years, particularly where problems pertaining to the scientific policies of the government have arisen

With renewed congratulations and best wishes, I remain,

To this letter President Campbell replied as follows

I have the great pleasure of acknowledging the receipt of your esteemed communication of to day which extends to the members of the National Academy of Sciences a warm welcome to Washington for the holding of the Academy's Annual Meeting of 1935, and expresses your cordial wish for the greater development and usefulness of the academy

Your letter was read to the members of the academy this afternoon at the opening of the first general assembly of this week s meeting, and I was requested and instructed to convey to you an expression of the academy's deep appreciation of your thoughtful and courteous message

I am also requested to assure you that the members of the academy are happy in their obligation and privilege of advising the government of the United States on subjects within the domain of the physical and the biological sciences whenever called upon by any branch or department of the government for such service, under the wise provision of the academy's congressional charter that "the Academy shall receive no compensation whatever for any services to the government"

ELECTION OF OFFICERS AND MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES

DR. FRANK R LILLIE, professor of embryology and dean of the Division of Biology at the University of Chicago, was elected president of the National Academy of Sciences at the Washington meeting He succeeds Dr W W Campbell, president emeritus of the University of California and director emeritus of the Lick Observatory Dr Lillie was also elected chairman of the National Research Council, in which office he succeeds Dr Isaiah Bowman, who has been called to the presidency of the Johns Hopkins University Dr Fred E Wright, of the Carnegie Institution of Washington, was reelected home secretary and Dr Henry Norris Russell, of Princeton University, and Dr Ross G Harrison, of Yale University, were re-elected members of the council

Members of the academy were elected as follows

Dr Norman Levi Bowen, petrologist, Geophysical Laboratory of the Carnegie Institution of Washington.

Dr Charles Manning Child, professor of zoology, University of Chicago

Dr George Ellett Coghill professor of comparative anatomy and member of the Wistar Institute of Anatomy, Philadelphia

Dr James Ewing, professor of oncology, Medical College, Cornell University

Dr Merritt Lyndon Fernald Fisher professor of natural history, Harvard University

Dr Harvey Fletcher, acoustical research director, Bell Telephone Laboratories, New York

Dr Ross Aiken Gortner, professor of biochemistry, University of Minnesota

Dr Earnest Albert Hooton, professor of anthropology, Harvard University

Dr Jerome Clark Hunsaker, professor of aerodynamics, Massachusetts Institute of Technology

Dr Walter Samuel Hunter, G Stanley Hall professor of genetic psychology, Clark University

Dr Dunham Jackson, professor of mathematics, University of Minnesota.

Dr Chester Ray Longwell professor of geology, Yale University

Dr Harold C Urey, professor of chemistry, Columbia University

Dr John Hasbrouck Van Vleck, professor of physics, University of Minnesota.

Two foreign associates were elected

Dr John Scott Haldane, Oxford, honorary professor and director of the Mining Research Laboratory at the University of Birmingham

Dr Jules Bordet, Pasteur Institute, Brussels

SCIENTIFIC NOTES AND NEWS

DR. FRANK B JEWETT, president of the Bell Telephone Laboratories and vice president in charge of development and research of the American Telephone and Telegraph Company, who has been awarded the Faraday Medal for distinguished services in the field of communications, sailed for England on April 23 in order that the medal may be presented to him

DR. RAYMOND M FUOSS, assistant professor of chemistry in Brown University, has received the American Chemical Society award in pure chemistry of $1,000 for work which resulted in the "first comprehensive theory of electrolytic solutions which, at lower concentrations, applies to all solvent media and to all electrolytes" The award, founded by Dr A. C Lang-

muir, recognizes "the accomplishment in North America of outstanding research in pure chemistry by a young man or woman under thirty one years of age"

AT the commencement exercises of Washington College, Chestertown, Md, the degree of doctor of laws will be conferred on Dr John M H Rowland, dean of the Medical School of the University of Maryland, and on Dr Robert L Swain, deputy commissioner of Food and Drugs of Maryland and past president of the American Pharmaceutical Society

THE doctorate of laws has been conferred by the University of Aberdeen on Professor E V Appleton, Wheatstone professor of physics at King's College, London, on Lieutenant Colonel A T Gage, formerly director of the Botanical Survey of India and superintendent of the Royal Botanic Gardens, Calcutta, and on Dr J C G Ledingham, professor of bacteriology, University of London, and director of the Lister Institute

AT the honorary graduation ceremony of the University of Liverpool, the degree of LL D will be conferred upon Charles Thurston Holland, formerly lecturer on radiology in the university, and on Professor Arthur Harden, lately head of the biochemical department of the Lister Institute

PROFESSOR GILBERT D HARRIS, emeritus professor of paleontology and stratigraphy at Cornell University, has been elected an honorary member of the American Association of Petroleum Geologists

FREDERICK H BAILEY, who has been a member of the faculty of the Massachusetts Institute of Technology since 1891, since 1907 as professor of mathematics, will retire at the end of the current academic year with the title emeritus

GORDON M FAIR, associate professor of sanitary engineering at Harvard University, has been promoted to a professorship

DR. WELDON G BROWN, now research assistant in chemistry at Columbia University, has been appointed assistant professor of chemistry at the University of Chicago in the field of inorganic chemistry W Lloyd Warner, now assistant professor of social psychology at Harvard University, has been appointed associate professor in the departments of sociology and anthropology

DR. QUENTIN D SINGEWALD, geology, and Rudolf Kingslake, geometrical optics, have been promoted to associate professorships at the University of Rochester, and Dr Curt Stern, zoology, has been promoted to an assistant professorship The title of associate professor now supersedes that of junior professor, hitherto employed by the university

AT Dartmouth College the following promotions have been made from assistant professor to professor, Leslie F Murch, physics, W Byers Unger, zoology, and Carl L Wilson, botany, from instructor to assistant professor, William W Ballard and Frank H Connell, zoology, and William P Kimball, civil engineering

DURING the summer session of the Iowa State College the department of agricultural economics will be augmented by three guest professors These are Professor J D Black, of Harvard University, Dr O E Baker, senior agricultural economist of the U S Department of Agriculture, and M L Wilson, Assistant Secretary of Agriculture

DR EUGENE CHAN has been appointed acting head of the department of ophthalmology at the Cheeloo University School of Medicine, Tsinan, Shantung, China, and concurrently chief of the Eye Service at the University Hospital He received his medical degree from Boston University and served his general internship at the Foote Memorial Hospital, Jackson, Mich He was on the staff of the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital from 1929 to 1934 Dr Theodore C Greene, a graduate of the Harvard Medical School has been appointed associate in medicine He was formerly assistant in pathology at the Johns Hopkins University and surgical house officer at Peter Bent Brigham Hospital, Boston He has been in China since 1927, having been connected with Douw Hospital in Peiping

SIR P CHALMERS MITCHELL has resigned as secretary of the Zoological Society, London

AT a meeting on April 15 of the Royal College of Physicians of London, Lord Dawson of Penn was re elected president

DR. A G BLACK, formerly head of the department of agricultural economics at the Iowa State College and since 1933 connected with the Agricultural Adjustment Administration at Washington has been appointed chief of the bureau of agricultural economics in the Department of Agriculture He succeeds Nils A Olsen, who resigned on April 15

S P KAIDANOVSKY has been appointed head of the Standards Unit of the Research and Planning Division of the NRA For the last twelve years, before his affiliation with the NRA, Mr Kaidanovsky was electrical and industrial engineer at the plant of the Westinghouse Electric and Manufacturing Company at Sharon, Pa

AT the second annual meeting of the Florida Botanical Garden and Arboretum Association recently held in Sebring, Dr A J Grout, of Newfane, Vt, and

Manatee, Fla, was elected president of the Board of Trustees Dr Grout recently retired after many years of service in the Boys High School of Brooklyn and the Curtis High School of Staten Island

DR F D MERRILL, director of the New York Botanical Garden, has returned after a visit to the Arnold Arboretum in Cienfuegos, Cuba

DR FORREST SHREVE and Dr T D Mallery of the Desert Laboratory of the Carnegie Institution, recently returned from an expedition to Lower California They were accompanied by Dr I L Wiggins, of Stanford University, and Jack Whitehead, of the Boyce Thompson Southwestern Arboretum The peninsula was traversed from the boundary to Cape San Lucas, and was crossed five times at different latitudes The objects of the expedition were the study of vegetation and the collecting of living plants and herbarium material

DR. ARTHUR SVIHLA, assistant professor of zoology and curator of the Charles R Conner Museum at the State College of Washington, and Mrs Svihla will sail on June 15 for Hawaii, where they will study the breeding habits of the Hawaiian rat in cooperation with the University of Hawaii

THE Walter Rathbone Bacon traveling scholarship of the Smithsonian Institution has been awarded to Dr Richard E Blackwelder now engaged in entomological work at the U S National Museum, for an intensive study of the staphylinid beetles of the West Indies Dr Blackwelder will collect these beetles on West Indian islands and will later study the large collections in the British Museum

DR KARL T COMPTON, president of the Massachusetts Institute of Technology, will give the Graduate School Convocation address at Brown University on June 15 The subject of his address will be Patterns in Our Ways of Thinking"

DR WILLIAM A WHITE professor of nervous and mental diseases at George Washington University and superintendent of Saint Elizabeth's Hospital, Washington, D C, recently delivered a series of three lectures to physicians, social workers and educators at the New York Academy of Medicine, under the auspices of the Salmon Committee for Psychiatry and Mental Hygiene

THE fifth lecture in the Smith Reed Russell series at the School of Medicine of the George Washington University was given before the faculty, students and invited guests on April 25 by Colonel Percy M Ashburn, superintendent of Columbia Hospital, Washington His subject was "The Medical History of the Conquest of America in the Sixteenth and Seventeenth Centuries."

THE Benjamin Knox Rachford Memorial Lectures of the University of Cincinnati were given by Dr R G Hoskins on March 21 and 22 The titles of the lectures were "Endocrinology of To-day" and "Endocrine Factors in Personality"

DR. TIMOTHY LEARY, medical examiner for Suffolk County, Massachusetts, and emeritus professor of pathology at Tufts College Medical School, Boston, will deliver the eleventh Ludvig Hektoen Lecture of the Frank Billings Foundation before the Institute of Medicine of Chicago on May 24 His subject will be "Atherosclerosis, the Important Form of Arteriosclerosis, a Metabolic Disease"

DR. ELIOT R CLARK, professor of anatomy in the University of Pennsylvania School of Medicine, formerly professor of anatomy in the University of Georgia School of Medicine, addressed a combined meeting of the University of Georgia Science Club and the Louis Dugas Journal Club of the School of Medicine, on April 15, at Augusta His subject was "Observations on the Vascular System"

DR. A FARKAS, of the University of Cambridge, gave the John Howard Appleton Lecture for 1934–1935 on April 17 at Brown University He spoke on "The Chemistry of Heavy Hydrogen"

DR. REXFORD GUY TUGWELL, Under Secretary of Agriculture, and Gifford Pinchot, formerly governor of Pennsylvania, will be among the speakers at the dinner to be given in Albany on May 15 to inaugurate New York State's celebration of the fiftieth anniversary of the Forest Commission, the forerunner of the present Conservation Department Robert Moses, chairman of the State Council of Parks and park commissioner of New York City, and Dr Henry S Graves, dean of the Forest School of Yale University, will also speak Henry Morgenthau, Jr, formerly State Conservation Commissioner, now Secretary of the Treasury, will attend the dinner The anniversary program includes a celebration at Niagara Falls and a two-day water pageant by the Central Adirondacks Association in central New York in July and a three day celebration at Lake Placid in September to which President Roosevelt has been invited

A SPECIAL symposium on the virus diseases of plants, animals and man, by the Botanical Society of Washington, D C, was held on April 24 Plant viruses were discussed by Dr L O Kunkel, director of the Phytopathological Laboratory of the Rockefeller Institute for Medical Research, Princeton, N J, and animal viruses, by Dr Earl B McKinley, dean of the Medical College of George Washington University

AT the recent meeting of the American Society of Biological Chemists in Detroit, the following officers

were elected *President,* Professor H B Lewis, University of Michigan, *Vice president,* Dr Glenn E Cullen, Children's Hospital Research Foundation, Cincinnati, *Secretary,* Professor Henry A Mattill University of Iowa, *Treasurer,* Professor Cyrus H Fiske, Harvard Medical School, *Member of the Council,* Professor J B Collip, McGill University, *Additional Members of the Council,* Professor H C Bradley, of the Massachusetts Institute of Technology, and Professor E A Doisy, St Louis University School of Medicine The next meeting will be held in Washington, D C, in the spring of 1936

THE twelfth initiation meeting of the University of Virginia Chapter of Sigma Xi was held on April 24 The meeting was addressed by Dr Ernest O Lawrence director of the Radiation Laboratory of the University of California, who spoke on "Artificial Radioactivity" The eleventh annual award of the President and Visitors' Research Prize of one hundred dollars was granted to Dr Alfred Chanutin, of the School of Biochemistry of the Department of Medicine, for a paper entitled, "Experimental Renal Insufficiency Produced by Partial Nephrectomy" The Andrew Fleming Prize of fifty dollars, awarded to a student in the Miller School of Biology, was given to Albert Lorz There were twenty-one initiates

AT the meeting of the American Academy of Tropical Medicine, which was held in New York City on April 16, the following new members were elected Dr Leland O Howard, Department of Agriculture Dr George H Whipple dean, School of Medicine, University of Rochester, Dr S Burt Wolbach, professor of pathology, Harvard Medical School, and Dr Hans Zinsser, professor of bacteriology Harvard Medical School The new officers elected were Colonel Charles F Craig, *president,* department of tropical medicine, Tulane University, Dr Richard P Strong, *vice president,* department of tropical medicine, Harvard Medical School The treasurer, Dr W W Cort, School of Hygiene and Public Health at the Johns Hopkins University, and the secretary, Dr Earl B McKinley, School of Medicine, the George Washington University, remain in office Dr George W Bachman, director of the School of Tropical Medicine, San Juan, Puerto Rico, was elected a member of the council to serve for two years. It was decided that hereafter the annual meeting of the academy will be held in conjunction with the meeting of the American Society of Tropical Medicine, the next meeting being scheduled for St Louis, Mo, next November

THE thirty seventh annual meeting of the Medical Library Association will be held in Rochester, N Y, from June 17 to 19 The program includes addresses, round-table discussions and demonstrations on library procedure, medical history and medical literature. The association is being represented by two delegates at the Congress of the International Federation of Library Associations to be held in Madrid from May 19 to 30 These delegates will return in time to report upon the congress The association consists of about 175 medical libraries of the United States and Canada together with their librarians and a group of supporting members of physicians interested in the advancement of medical libraries The officers of the association are as follows Charles Frankenberger, *president,* Brooklyn N Y, Louise Ophuls, *vice president,* San Francisco, Cal, Frances N A Whitman, *secretary,* Boston, Mass, Mary Louise Marshall, *treasurer,* New Orleans, La, Marjorie J Darrach, chairman of the executive committee, Detroit, Mich

THE second annual Maryland Biology Teachers' Convention met at the Maryland Academy of Sciences building in Baltimore, on April 13, with 102 high school and college teachers of biology in attendance At the morning session, Dr R W Hegner, of the School of Hygiene and Public Health of the Johns Hopkins University, spoke on Recent Advances in Protozoology", Elra Palmer, secretary of the Natural History Society of Maryland, on Collecting, Preserving and Preparing Laboratory Organisms" and Dr J B S Norton, of the University of Maryland, on "Maryland Ecology" At the afternoon session, Dr Raymond Pearl, of the Department of Biology of the School of Hygiene and Public Health of the Johns Hopkins University, spoke on 'Human Biology in High School and College", W J Morse, of the Bureau of Plant Industry, U S Department of Agriculture, on 'The Soy Bean,' and Dr Herbert S Davis, of the U S Department of Fisheries, on "Recent Advances in Fishery Biology and Aquiculture" In the evening the biologists were the guests of the academy to hear a lecture entitled 'Glimpses of Kangarooland" by Captain Stanley Osborne At the business session, a council of nine members was elected, with Dr R V Truitt, of the University of Maryland, as chairman, Miss Marion Janney, of the Baltimore City Schools, as secretary, and Dr C L Newcombe, of the University of Maryland, as treasurer The next session will take place at the University of Maryland next spring

ACCORDING to *The Museum News,* Secretary of the Interior Ickes has recommended the formation of an international park in the Big Bend area of the Rio Grande River The recommendation suggests the authorization of a National Park of about 5,500 acres on the Texas side of the border and an invitation to the Mexican government to establish a park on the Mexican side, the two to form an international peace park. The area includes the Chisos Mountains and semi-arid plains along the river, the last wilderness of Texas

DISCUSSION

INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

From the record, it would appear that biologists are the least internationally minded of American scientists At any rate the biologists are the only group who have not adhered to the appropriate International Union This is perhaps a matter of surprise in view of the facts that a Union of American Biological Societies comprising 25 different organizations has been formed and is functioning effectively in the production of *Biological Abstracts* and that international congresses of botany, zoology pathology, entomology, genetics and the like have been held at intervals for many years The botanists, in particular, ought to be interested in a permanent organization, because the old International Botanical Congress was dissolved in 1915 A fourth congress held at Ithaca, N Y, in 1926 a fifth at Cambridge, England, in 1930 and a sixth to be held at Amsterdam in September, 1935, continue the series in name only There is no permanent organization, and each congress is reorganized by the botanists of the country that acts as host The hosts are under no compulsion to recognize interim committees that may have been authorized in a sectional meeting of a previous congress, although a committee on nomenclature, including surviving members of the pre-war committee, does function by common consent This lack of continuity from congress to congress represents a distinct loss to science not only because international cooperation is not encouraged—it is in fact discouraged—but also because of the considerable expenditure of time and energy on the part of scientists in the sterile business of effecting reorganizations The discouragement to progress lies in the fact that interim committees are not at work on problems that from their very nature can be forwarded best if at all by international cooperation Programs are made up by an organizing committee in one country rather than by the international groups that are intimately acquainted with the currently vital problems of a particular field It is almost inconceivable that the subject of nomenclature should be handled in a congress without the guidance of a permanent committee that functions continuously

The fact that microbiologists, geneticists, pathologists, ecologists and others maintain international organizations is sufficient evidence that such congresses are needed About the only questions involved are (1) whether these groups should meet separately or whether artificial lines should be ignored and all biology be brought in for group discussions, and (2) whether the large number of groups should each meet separately or whether they should join under the leadership of the International Union of Biological Sciences and hold international biological congresses

The objection often raised to large gatherings of scientists is not particularly important in this connection In the first place, only biologists would be in attendance and in the second place there is no particular point to finishing off a convention in the shortest possible time Let the sessions extend over a fortnight if there is any occasion It is to be hoped that enough new things of international significance are found out in the realm of biology so that once in five years a period of 12 or 14 days is not too long for the proper discussion of the advances made

The following countries are now adherents of the International Union of Biological Sciences Belgium, Czechoslovakia, France, Great Britain, Holland, Italy, Japan, Poland, Portugal, South Africa, Switzerland There is no reason to believe that the absence of Austria, Germany or U S S R from this list is more significant than the absence of U S A

In recent months at least two societies (Botanical Society of America and American Phytopathological Society), representing about 2,000 individuals, have filed resolutions with the chairman of the Division for Biology and Agriculture of the National Research Council favoring early adherence to the International Union

An extraordinary session of the Union is scheduled to be held in Amsterdam on September 1, 1935, to consider amendments to the statutes A joint session of the Union, Section of Botany, and the Botanical Congress will be held on Wednesday of the same week It is practically certain that at the joint session Professor Went will propose, as he did at Ithaca in 1926, that the two bodies merge Such a fusion is a logical step and is likely to be voted The Botanical Congress would thus become a permanent and continuing organization, with a central bureau subsidized by the governments of the adhering countries The statutes of the Union are so comprehensive that the various sections which now exist or may be set up enjoy almost complete autonomy Under the circumstances, any biological organization in U S A that sponsors international congresses might well consider the advantages of the International Union as the medium for accomplishing the purposes of such gatherings Needless to say, American botanists, who are confronted with the immediate problem of becoming eligible to participate in the joint sessions of the Union and the congress in September next, will appreciate the support which other biological organizations could give Doubtless the Division for Biology and Agriculture of the National Research Council would welcome expression of opinion about the advisability

of adhering to the Union If strong reasons exist for remaining out of the Union, unquestionably the division would welcome such information, as would also the 2,000 botanists who are now disposed to enter

DONALD REDDICK

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HEVEA RUBBER TREES IN FLORIDA

THE Hevea or Para rubber tree of Brazil (*Hevea brasiliensis*), the species that is cultivated extensively in the East Indies, has been introduced experimentally into southern Florida, where the coconut palm, mango, avocado, sapodilla and other strictly tropical plants are being grown Some of the rubber trees have grown rapidly, and have produced fertile seeds so that the first generation of "native-born" Heveas is in its second year A single stunted Hevea tree at Palm Beach is the only known survivor of an earlier introduction, at the end of the last century, by the U S Department of Agriculture, and has shown notable resistance to unfavorable conditions It was broken off near the ground by the fall of another tree in the hurricane of 1928, but the stump has remained healthy and new branches have developed

Although the native habitat of Hevea is in the Amazon valley, which lies along the Equator, the susceptibility to injury by cold weather appears to be rather less than that of the Castilla rubber trees from Central America and Mexico Many tropical plants are damaged in cool periods, even in regions where frosts do not occur, but no such tendency has been noted with Hevea, even in the young plants, many of which have continued to grow through the winter The seasonal leaf fall of the older trees, which is a regular habit of Hevea in the tropics, may assist the adaptation of the species to the Florida conditions In addition to Hevea and Castilla, the rubber experiments that are being conducted at the Plant Introduction Garden at Coconut Grove include the Ceara rubber tree of Brazil (*Manihot glaziovii*), the African rubber tree (*Funtumia elastica*) and the Assam rubber tree (*Ficus elastica*), which also are thriving and seeding under the Florida conditions

The seedlings of the Hevea tree are notably specialized for forest undergrowth conditions and have very thin leaves Protection of the young trees against the strong trade-wind breezes of the coast districts was found necessary, and the roots must reach permanent moisture, but the older trees are relatively hardy The most normal and rapid growth has been in pockets of the limestone reef formation below Coconut Grove, though practical tests of production possibilities are not to be made under such conditions The first requirement for adequate testing is that supplies of native grown seed be available for planting in many localities, so that the general range of adaptation may be learned and permanent groups of trees established where soil conditions prove favorable, to give a basis of selection The factor of selective adaptation may be emphasized on account of the very wide range of individual diversity in Hevea

The extent to which it will be desirable to utilize Hevea or other tropical rubber trees in southern Florida no doubt will depend upon the efficiency of production that can be attained, and upon the need that may be felt for developing new industries or of protecting ourselves against military emergencies and commercial exactions A limiting factor at present is the denuded state of much of the interior but with the fire hazards removed and the natural forest covering restored, the tropical reclamation might extend over half the peninsula Desert conditions are approached in the open fire swept country during the dry season of the winter and early spring with the exposed sand losing heat rapidly after sunset and the dry cold air inducing frost temperatures in moist places by surface evaporation Water that is being drained from Lake Okeechobee and higher levels farther north could be diverted for controlling fires and irrigating the tropical districts in the dry season, if large scale developments of rubber or other tropical resources were undertaken

O F COOK

BUREAU OF PLANT INDUSTRY
FEB 2, 1935

"SLEEP" AGGREGATION IN THE BEETLE ALTICA BIMARGINATA

As an addition to our comparatively limited knowledge of "sleep' aggregations in insects the following notes may be of value

On July 29 and 30, 1934, while camping on a small stream near Missoula, Montana, I found large clusters of this species collected on trunks of alder trees, close to the stream The weather was intensely hot, with maximum temperature at Missoula of 99° F, on the 29th, and a strong breeze from the southeast

The beetles were gathered in dense clusters mostly on the leeward side of the alders in long vertical rows, occasionally one being on top of the others For the most part they were quiet, but an occasional "sleep walker" would leave his comrades to crawl up the trunk and then down again

I removed a lot and threw them on the ground Here they ran aimlessly about until reaching some blades of grass up which several of them climbed to reach an alder trunk, which they ascended and wandered up and down for a time until coming into contact with other beetles, when they gradually came to rest close to their fellows

When a wandering beetle made contact with one at rest, the latter frequently turned about as if to repel (?) the intruder, while the antennae of both were in active motion They would then come to rest together

or the visitor might move on, as though to seek a more friendly "bed fellow"

During most of the day the beetles were in shadow, but toward evening streaks of sunlight fell upon them, causing them to shift their position, so that the configuration of the group was materially changed Whether light or heat or both were the disturbing factors I can not say

At 6 10 P M or about 5 minutes before the sun sank behind a nearby mountain, the beetles started to ascend the trees But while the general movement was up a few of the beetles would reverse their direction and move down for a time At 6 20, after the sun had disappeared, there was a great pilgrimage upward, but a few laggards were still "asleep" By 7 10 all but one had ascended the particular tree which I was observing, and by 7 30 all had gone up

The following morning was partly cloudy and still Most of the insects had moved to other trees in the vicinity, but a few were in the same location as on the two preceding days At 9 15 A M, or more than two hours after the sun had reached the top of the alders, a few of the beetles had come down the trunks or were wandering aimlessly up and down, while others were still in the tree tops At 11 A M I noted several groups of from 10 to 20 beetles on the trunks of several trees, but many were still resting quietly on the leaves or flying from leaf to leaf, but apparently not feeding

Further observations on the "sleep" behavior of insects and the rôle of various environmental and physiological factors in its control are desirable

R T YOUNG

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NOTES ON THE COMMON SHRIMP

FOR about a year I have had in my aquarium a number of the common fresh-water shrimp—*Palaemonetes exilipes* In general these specimens were fed on bread crumbs and bits of scrambled egg One morning during the latter part of September, I introduced quite a number of mosquito larvae—(*Culex* sp) into the aquarium The shrimp at once began to chase the larvae Even among the plants and grasses of the aquarium the larvae were easily captured The shrimp held the larvae in their pinchers, introduced the still struggling larvae into the mouth and gradually consumed them

This does not present proof that in its natural environment *Palaemonetes exilipes* eats the larvae of the mosquito However, since it positively occurs in an aquarium, it seems probable that such is the case in the natural habitat of these shrimp Such feeding habits make Palaemonetes very valuable economically

G ROBERT LUNZ, JR

CHARLESTON MUSEUM

REPORTS

RESEARCH AT MELLON INSTITUTE DURING 1934-35

THE steady advancement of Mellon Institute during the past twenty four years is frequently cited as an illustration of the esteem in which industrial research is held by American manufacturers The institution was one of the first organizations in the United States founded expressly for investigating the problems of the industries, and its industrial fellowships, which have now passed the one thousand mark, have served scientifically 3,600 companies, either as individuals or as members of industrial associations In ten instances the inventions of fellowships have created new industries and as the results of research accomplishments of other fellowships many new branches have been added to existing manufactures The triple function of the institute as an industrial experiment station, as a training school for industrial scientists and as a center for investigation in pure as well as applied chemistry is seen in the numerous discoveries the successful processes and products, achieved under its auspices and in the regiment of keen research men who have here acquired specialized knowledge and experience that they are now applying productively in other fields

In his twenty second annual report to the institute's board of trustees, just issued, Dr E R Weidlein, director, has summarized the progress during the fiscal year ended February 28, 1935 That there was a growth of the institute's activities in this period is shown by the funds contributed by the industries for the support of research, which amounted to $596,937 68, an increase of 11 per cent over the preceding year The money appropriated by companies and associations to the institute during the past twenty four years amounts to $10,029,544

At the close of the fiscal year, 56 industrial research programs, each relating to a major problem of technology, different in subject from the others, were being pursued, 16 by multiple industrial fellowships and 40 by individual industrial fellowships Eighty-seven fellows and 29 assistants held positions thereon Twenty eight fellowships, or half the total number, have been in operation for five years or more, and of these fellowships 14 have concluded ten years of research, eight have been at work for 15 years or more,

and three fellowships are 20 years of age or older These data demonstrate that there is a growing realization by industrialists that long range basic research is profitable Throughout the fiscal year (March 1, 1934, to March 1, 1935) 62 industrial fellowships—17 multiple and 45 individual fellowships—were active, and these different investigations required the services of 97 fellows and 48 assistants during all or part of the year During the calendar year 1934, publications by members of the institute included 11 bulletins, 19 research reports and 41 other papers Fifty two United States patents and 49 foreign patents were issued to fellows

The income of the institute from industrial fellowship donors is expended in carrying on scientific researches of concern to these companies and associations The institution also has funds that enable it to sustain a department of research in pure chemistry and to support certain investigations of general importance to public welfare, such as, for example, the broad study of air hygiene by H B Meller and his coworkers, in progress since 1928 Through its department of research in pure chemistry the institute is according constantly increasing attention to the encouragement of thoroughgoing investigations of fundamental chemical problems This attitude is the result of altruistic motives and of the realization that such studies are essential as a background and stimulus for industrial research Since this department was founded in 1927, it has contributed much to the literature of pure organic chemistry During recent months its studies have been concentrated on cinchona alkaloids, in following lines which might lead to compounds of value therapeutically in pneumonia So far 59 different preparations have been tested for toxicity, protection against lethal doses of pneumococci in animals and pneumococcocidal power in vitro Many biological and clinical data are being gathered by the department's medical collaborators, Drs W W G Maclachlan, H H Permar, John M Johnston, Joseph R Kenny and H B Burchell, at Mercy Hospital, Pittsburgh To date the most interesting compounds studied, from the medical point of view, have been hydroxyethylhydrocupreine, apoquinine, ethylapoquinine, and hydroxyethylapoquinine The experimental findings and clinical observations are being published at the conclusion of definite stages of progress in this large investigation The department's staff is now constituted of Dr L H Cretcher, head, Dr C L Butler, Miss Alice G Renfrew, Dr B L Souther and Miss Mary Hosler

The cooperative work with the Institute of Pathology of the Western Pennsylvania Hospital, made through arrangements with Dr C B Schildecker, is being continued These studies, which are being conducted by twelve scientists under the direction of Dr R R Mellon, also pertain to pneumonia and allied pulmonary diseases Considerable advancement has been made in an anti pneumococcic serum and an anti streptococcic serum

Mellon Institute has taken an active part, during the past five years, in the preparation of the eleventh revision of the 'United States Pharmacopoeia" Dr G D Beal, assistant director of the institute, is a member of several of the committees, and, aided by C R Szalkowski, has completed a comprehensive series of studies in the five year period Six researches have been published and as many more will appear soon

Information concerning the subject matter and progress of many of the industrial fellowships is not releasable, but the institute is privileged to describe some of the developments during the fiscal year, as follows The carbon black fellowship, whose incumbent is Dr C W Sweitzer, has made a basic investigation of the dispersion properties of carbon blacks that has led to the development of a method for colloidally dispersing carbon black pigments in lacquer vehicles, this colloidal dispersion resulting in markedly improved properties for the black lacquer The fellowship on ceramic chemicals has given attention to several aspects of enameling procedure, and W J Baldwin, the incumbent, has carried into the plant stage of development an improved enameling process A research creation of the multiple fellowship on protected metals, 'Tile-Faced Robertson Protected Metal," developed by D S Hubbell, has been shown to have an immediate, broad market in the building material field, because of the combination of an attractive ceramic surface upon a core of asphalt asbestos protected metal The multiple fellowship on refractories, headed by S M Phelps, has continued research on new test methods for evaluating progress in developmental work and for the control of commercial products while being manufactured, and has evolved the panel spalling test and two improved analytical methods The same fellowship has also investigated the effect of furnace gas pressure on the behavior of refractories in industrial furnaces During the past two years Dr B H Gilmore, on the calgonizing fellowship, has carried out comprehensive research on the rôle of sodium hexametaphosphate in sequestering calcium and magnesium ions as they affect detergent operations in which soap is used or formed By removing these ions from solution without precipitation, the curdling effect of hard water upon soap is completely inhibited and the soap used in washing operations is held in solution to exercise its full detergent action Sodium hexametaphosphate, in consequence, is being employed extensively in laundering and in mechanical dishwashing, it is also useful for cleaning the foliage of evergreen shrubbery and for

pet-washing Drs W W Duecker and C R Payne on the multiple fellowship on sulfur have found that acid resistant cements, made by combining sulfur with an aggregate, can be improved by the addition of certain olefine polysulfides, and that such modified cements are valuable bonding agents and protective coatings in structures subjected to acids or corrosive solutions On the shaving fellowship E J Casselman has been studying safety razor guard bar design and razor blade quality, he has developed a procedure that has resulted in the advancement of the technique of controlling factory methods for sharpening blades as well as enabling the manufacturer to specify the correct quality of blade steel The multiple fellowship on organic synthesis (Dr E W Reid, senior fellow) has been remarkably successful in preparing new, commercially valuable compounds for a wide variety of uses glycol ethers, novel plasticizers, new types of vinyl resins, triethylene tetramine, and morpholine derivatives Two new strained foods (a cereal and apricots) have been developed by the food varieties fellowship, and E R Harding, the senior fellow, and Miss Helen B Wigman have continued their study of vitamin C On the sugar fellowship Dr G J Cox and Miss Mary L Dodds attained in 1934 results that suggest the existence of a factor which, if present in the diet during a critical period of tooth formation, will aid in the construction of teeth resistant to decay The useful chemicals that this fellowship demonstrated could be produced from sugar, such as sucrose octa-acetate, calcium levulinate and the ethers of levulinic acid, are now being manufactured by an industrial organization

Seven new fellowships began operation during the fiscal year—starch, stone, closure, zymology, demulcent, laboratory and thread Another fellowship, on soya bean, started work on March 1, 1935 The following fellowships concluded their research programs during the year cleaning, velvet, vanadium, sugar, phosphates and paper finishing

It is announced that the new building of the institute will be gradually occupied during 1935 The chemical engineering quarters are practically finished and many of the new laboratories will be ready for occupancy within the next few months It is planned to have the building completed by the end of 1935 The first use of the edifice was to house the Science Exhibition held in connection with the Pittsburgh meeting of the American Association for the Advancement of Science More than 25,000 persons visited this exhibition, which was open from December 27 to 30, 1934

W A HAMOR,
Assistant Director

MELLON INSTITUTE OF INDUSTRIAL RESEARCH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PARADICHLOROBENZENE, AN EFFECTIVE HERBARIUM INSECTICIDE[1]

THE plants in an herbarium must be kept free from pests This is commonly done by periodic fumigation with hydrogen cyanide or carbon bisulfide Such methods require either an airtight case in which to carry on fumigation or the general herbarium cases sufficiently airtight to retain the fumes within the case Both methods may have serious after effects if the substances are not adequately cleared out of the air In our case with neither a fumigating case and far from airtight herbarium cases, neither of these methods could be used Routine poisoning of new specimens checked the introduction of new pests but did not free the old plants

Taking a tip from the entomologists, we decided to try out paradichlorobenzene We have found it an immense success In practice a small unsealed envelope with about a heaping teaspoonful of paradichlorobenzene is put somewhere in the herbarium case In our practice one such envelope is put at the bottom of the case and does for two columns of 17 pigeonholes each The chemical volatilizes in the course of two or three weeks The fumes penetrate the compartments and in a few days diffuse out around the doors We have done this for our whole herbarium towards the close of the school year for the past two years In the first fall following this treatment, we were able to find living pests in a bulky specimen of Asclepias, a few pupae in other Asclepiases and in one legume Thousands of dead larvae and pupae scattered through the herbarium were mute testimony to the action of the paradichlorobenzene Following the second year of such treatment, we have been able to discover no living pests anywhere in the herbarium

The same substance may be employed in fumigating duplicates or in recent accessions which have not yet been mounted The simple practice is to put a small amount in an envelope in the ordinary pasteboard boxes that plants are stored in and allow it to remain until one is ready to use the plants No effort is made to keep these boxes airtight, but they are usually tied up In thus treating one group of plants

[1] Contribution No 346 from the Department of Botany and Plant Pathology, Kansas State College of Agriculture and Applied Science, Manhattan, Kansas

which we knew to be very badly infested with larvae, we closed the box with gummed paper except for one corner where a small hole about 2 mm wide was left When this box was opened up a month later, hundreds of dead larvae were found in the immediate vicinity of this hole in the box and still more hundreds were in the plants in the sheets from which they had been unable to escape

The substance paradichlorobenzene kills not only the larvae and pupae, but also the eggs It, of course, takes longer exposure to kill the eggs, but entomologists feel that the presence of a highly saturated atmosphere for two weeks will do this It is our experience that this is undoubtedly the case

In summary, paradichlorobenzene has been found to be an inexpensive, very proficient means of carrying on herbarium fumigation *in situ* as it kills all forms of the pests with a minimum of caretaker's discomfort and is not a fire hazard

FRANK C GATES

MANHATTAN KANSAS

AN IMPROVED METHOD FOR SEED GERMINATION

IN germinating seeds on either wet blotting paper or towelling paper, certain difficulties are often encountered Chief of these is the development of root hairs into the surface of the substrata and subsequent difficulty in removing the germinated seeds without injury A second problem is met with in keeping the seeds in a humid atmosphere most conducive to germination The method described was designed to eliminate these problems

Number 300 Cellophane (thin wrapping Cellophane), previously soaked in distilled water for a period of an hour or more to remove the glycerine, is placed wet upon a saturated pad of several sheets of blotting paper, or paper or cloth towelling The Cellophane presents a very smooth surface to which the root hairs do not adhere

The seeds are placed on the Cellophane and the blotting pad is placed in the bottom of a miniature greenhouse or other suitable enclosure, such as a bell jar Thus a moist atmosphere is provided and excessive evaporation from the blotting pad is prevented

In case seeds are to be germinated for planting purposes, sterilized wet fine sand may be used in place of the Cellophane and blotting pad In this case, the seeds should be oriented for planting, the radicle in a vertical position Seeds as large as those of pea, bean and corn may be germinated successfully in this manner

A particular advantage of using glass topped boxes or bell jars lies in the fact that the process of germination may be observed without disturbing the seeds This procedure is good for preparing germinated seeds for the demonstration of root hairs

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SPECIAL ARTICLES

MENINGITIS IN MAN CAUSED BY A FILTERABLE VIRUS

DURING December of 1934 two adult males, W E and R E S, developed an illness characterized by headache, vomiting, stiff neck and a high cell count, 1,700 and 720 per c mm, respectively, in the spinal fluid The cells in the fluid were practically all mononuclear elements Both patients made a slow uneventful recovery and are now well

The clinical pictures presented by the patients were almost identical and suggested a virus meningitis Consequently, spinal fluid from each of them was inoculated intranasally, intraperitoneally and intracerebrally into 6 Swiss albino mice

Of the 6 mice that received W E's spinal fluid, one died on the third day of a streptococcal infection and was discarded The remaining 5 mice became sick 6 or 7 days after inoculation One of them died and was discarded, 2 were allowed to recover and 2 were killed in order to prepare a brain emulsion for intracerebral inoculation of other mice The second lot of mice became sick about a week after inoculation and some of them were sacrificed for passage By means of emulsions of bacteriologically sterile brain material injected intracerebrally into mice the active agent has been passed serially through 10 lots of mice and at present small amounts of a 10 per cent emulsion of infectious brain material kill practically all the mice in 7 days

In a similar manner an active agent free from bacteria was obtained by the inoculation of R E S's spinal fluid into Swiss mice The virus has been passed through 9 sets of mice and reinoculation experiments clearly show that the W E and R E S strains are immunologically identical

Mice inoculated intracerebrally with either strain of virus become sick within 5 to 7 days and lose weight rapidly Their fur is ruffled Only a few of them develop signs referable to the central nervous system which consist of irritability and convulsions No paralyses have been noted The virus is in the brain, liver, lungs and blood Mice inoculated intraperi-

toneally become sick, but only a few of them die Intranasal inoculations of the virus cause no visible illness in mice but immunize them against the virus injected intracerebrally The chief lesions found in mice are a mononuclear cell meningitis, a hyperplasia of Kupffer cells in the liver, and a pneumonia similar to that caused by other filterable viruses

The virus causes no lesions in the skin of rabbits, and when it is inoculated intracerebrally the animals only exhibit a fever of short duration We have no definite evidence, therefore, that rabbits are susceptible to this active agent

Guinea pigs are susceptible to both strains of the virus inoculated either intracerebrally or subcutaneously A high continued fever (104–106° F) and loss of weight are the striking features of the infection in this host Death usually occurs 10 to 14 days after intracerebral inoculation and many of the pigs die after subcutaneous injections A slight meningitis or a virus pneumonia is all that our pathological studies have revealed so far

Monkeys (*M rhesus*) are susceptible to the active agent introduced intracerebrally, as evidenced by high fever, loss of weight and irritability No paralyses have been noted From the small number of monkeys injected we judge that the disease will not as a rule be fatal for this host

From tissues containing the active agent no ordinary bacteria that might be of etiological significance have been cultivated Furthermore, the virus passes through Seitz pads, Berkefeld V, N and W candles, and collodion membranes possessing an average pore diameter of 210 $\mu\mu$ Additional work is under way to determine the size of the virus

The results of our experiments seem to indicate clearly that the virus was obtained from the spinal fluid collected from the two patients and that it is pathogenic for man Two mice that received W E's spinal fluid and recovered and 5 mice that received R E S's spinal fluid and did not become sick were later found to be solidly immune to virus introduced intracerebrally We have not encountered any immune animals among our stock mice Consequently, we believe that the immune mice mentioned above realized that state through having received an immunizing dose of virus in the spinal fluid Furthermore, neutralization tests conducted in mice and guinea pigs show that serum collected from the patients at the beginning of their illness fails to neutralize the virus, while serum collected late in convalescence does inhibit its activity In passing it should be noted that neutralizing antibodies appear very slowly in the sera of guinea pigs, monkeys and human beings convalescing from an infection with the virus

Our virus is not similar to any active agent heretofore described, with the exception of those of Armstrong and Lillie[1] and Traub[2] The former workers speak of the source of their virus in the following manner "It is not apparent whether this virus came from the case C G or from one of the monkeys used in the transfer of virus from this case In either event the virus was apparently in a latent state and was activated during successive transfers" Traub has clearly shown that he recovered his virus from stock mice We are confident that our strains of the virus were obtained from the spinal fluids of two patients and that it is pathogenic for man Through the cooperation of Dr Armstrong and Dr Traub it has been possible for us to show that the viruses recovered from the three sources mentioned above are either immunologically identical or at least very closely related

Many filterable viruses naturally attack the central nervous system of man and lower animals, causing an encephalitis and can be recovered from the brain or spinal cord So far no virus has been shown to produce a clean cut picture of meningitis in man The new agent with which we are working seems to be able to produce such a picture and to appear in appreciable amounts in the spinal fluids of affected individuals Whether this virus produces only a picture of meningitis in man and how great a rôle it plays in diseases of the central nervous system remains to be determined

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ON CYMAROSE

CYMAROSE is a methyl ether of a 2 desoxy hexomethylose (2 desoxymethylpentose) which occurs in the cardiac glycosides cymarin and periplocymarin It was first obtained by Windaus and Hermanns[1] from cymarin They noted that it gave no phenyl osazone, but that it yielded acetic acid on oxidation with silver oxide and exhibited the color reactions of digitoxose They therefore suggested that it may be a methyl ether of this desoxysugar Attempts to demethylate it to digitoxose were unsuccessful and the position occupied by the methoxyl group as well as its precise configuration remained undetermined

It is now possible definitely to allocate the methyl ether group at the third carbon atom of the desoxyhexose chain When cymarose was oxidized with 50 per cent nitric acid, a hydroxymethoxyglutaric acid

[1] C Armstrong and R D Lillie, *Pub Health Rep*, 49 1019, 1934

[2] E Traub, SCIENCE, 81 298, 1935

[1] A Windaus and L. Hermanns, *Ber chem. Ges*, 48 979, 1915

was formed which was characterized by its di N methylamide The latter melted at 138° and showed $[\alpha]_D^{24} = -55.3°$ ($c = 1.410$ in water)

$C_8H_{16}O_4N_2$

Calculated	C 47.04,	H 7.89	OCH_3 15.19,	$(N)CH_3$ 14.70
Found	" 47.12,	" 7.42,	" 15.70,	13.41

It was also possible to isolate the lactone of this acid which melted at 150–152° and showed $[\alpha]_D^{24} = -1.2°$ ($c = 1.720$ in water)

$C_6H_8O_5$	Calculated	C 45.00	H 5.00	OCH_3 19.37
	Found	45.15	4.98,	19.22

On direct titration and saponification the alkali consumption corresponded to one carboxyl and one lactone group, respectively From this it is obvious that in order that lactone formation may take place the hydroxyl group of this acid must be on a carbon atom adjacent to one of the carboxyl groups This leaves only the β carbon atom as the position for the methoxyl group Otherwise the highly improbable assumption of the presence of a β lactone must be made By reference to the cymarose molecule it follows from this that the methoxyl group is on the third carbon atom of the desoxyhexose

Details of this work, together with the exact determination of the configuration of cymarose, will appear later

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THE EFFECT OF PRACTICE UPON INTERCORRELATIONS OF MOTOR SKILLS

EXPERIMENTS on the interrelations of speed[1] tests in fine motor skills have indicated quite consistently that these tests are either highly specific or at most related only within very narrow groups of movement patterns, *e g* as in McCollom's tapping tests[2] According to Seashore,[3] an intercorrelation of approximately + 25 would be a representative figure for such tests, but such results have been challenged, since learning curves have been involved, and testing may not have been done near enough to hypothetical physiological limits The critical test is to train observers until they are making little improvement comparing the intercorrelations between the various motor tests at the beginning and end of the practice period If intercorrelations increase materially by the end of the practice period, it would favor the theory that a general factor or perhaps several large group factors are basic to more complex motor skills

The Koerth Pursuit Rotor[4]—a test of simple eye hand coordination in following with a stylus a target mounted on an insulating disk which is revolved quite rapidly by a phonograph motor—and the Brown Spool Packer[4]—a test of eye two hand coordination in speed of packing spools into a tray—were selected as unlike performances If after practice, intercorrelations raised materially between these qualitatively very different skills, the evidence would strongly favor the theory of a general motor ability or large and overlapping group factors

To test for a possible narrower group factor, this experiment included two tapping tests which are known to be unrelated in early trials, but which seem qualitatively enough alike to belong to a single basic motor capacity' which might be determined by a hypothetical physiological limit of neuro muscular arm speed These two tests were McCollom s simple tapping of a telegraph key and the alternate tapping of two brass plates with a stylus both for speed If sheer physiological limits are the basic determiners of fine motor speeds, this should be shown by a raise in the intercorrelations of these two tests

A lengthy preliminary study determined the respective learning curves and the number of trials necessary to reach approximate limits of improvement on each test Practise periods were given by the rotating cycle method so as to avoid fatigue A single cycle consisted of 5 trials of 20 revolutions each on the pursuit rotor 3 trials of 5 seconds each on the telegraph key 2 trials of 1½ minutes each on the Brown Spool Packer 5 trials of 20 revolutions each on the pursuit rotor 3 trials of 5 seconds each on alternate tapping Three cycles per day were performed at the same hour on alternate days so that a total of nine cycles, or about three hours of spaced practice was had by each observer Motor tests are usually interesting to men, and the citation of electrical counter scores after each trial added a distinct motivation to the performances

Fifty male right handed laboratory students acted as observers, none of them having had previous practise on these tests

Correlations between scores on cycles 2 and 3 (first day) in each test were determined for reliabilities, and these were duplicated for cycles 8 and 9 (third day) Intercorrelations for the four tests were computed from the total of scores on cycles 2 and 3 (first day) and similarly from totals of cycles 8 and 9 (third day) Since the intercorrelations between the tests were determined from the sum of two commonest while reliabilities were computed from the corrmmenda ahn by an

[1] The results of steadiness tests and large muscle athletic coordinations must be considered separately from *fine* motor *speed* coordinations of Seashore and Adams SCIENCE 78 2022, 285–287, September 29, 1933

[2] I N McCollom, "Analysis of Factors Determining Individual Differences in Speed of Simple Repetitive Motion," unpublished thesis, University of Oregon Library

[3] R. H. Seashore, *Jour of Gen. Psychol*, iii 1, 38–66, 1930

[4] R. H Seashore, *Psychol. Monog*, xxxix 2, 1928

TABLE I

Effect of Practise on Intercorrelations of Four Motor Speed Tests

	Koerth Rot	Tel Tap	Br Sp Pkr	Alt Tap
Koerth Rot.	* 91 * 85 (95) - 03 (92)	.25 39 + 14	32 31 - 01	08 02 - 10
Tel Tap		* 77 * 91 (87) + 08 (95)	40 14 - 26	30 07 - 23
Br Sp Pkr			* 86 * 88 (93) + 01 (94)	15 04 - 11
Alt Tap				* 81 * 84 (90) + 01 (91)

Light figures - results of first day's practice Heavy figures = results of last day's practice Figures showing plus or minus variation as result of practice indicated by algebraic sign. * = reliability coefficients, Brown Spearman figures in parenthesis

between single cycles, the *reliability* of the measures intercorrelated was estimated by the Brown Spearman prophecy formula, as shown in parentheses below each of the obtained reliability coefficients

As seen in Table I, intercorrelations between the four motor skills at the beginning of the practice period (light figures) verify the previous findings of low positive correlation between these separate skills, ranging from r=+ 08 to r=+ 40, approximating a value of r=+ 25 After the practise period the correlations (in heavy figures) are somewhat lower than at the beginning of practise They now range from r=- 02 to r=+ 39, averaging r=+ 16 Four of the six interrelationships now approximate zero, suggesting that the effect of intensive practice, if anything, is to make such motor skills not only more specific than they were at first, but practically independent variables Reliability coefficients for both sets of intercorrelations are high, tending slightly higher after practice.

The correlation between the Koerth Pursuit Rotor and Brown Spool Packer (unlike tests) changed but very little (- 01), denying the importance of general factors of motor skill The correlation between telegraph tapping speed and alternate tapping speed dropped from + 30 ± 09 at the beginning of practice to + 07 ± 10, denying even the existence of a group factor large enough to include only tapping performances

It is therefore concluded that with instrumentally controlled testing and statistically reliable measures, the effect of practise on the intercorrelations of speed in fine motor skills is, if anything, to decrease their relationship, thus upholding previous findings as to the specific nature of the skills tested Our results ne not support the hypothesis of one or a few physioof ical limits, such as neuro-muscular arm speed, valeh might be thought of as determinants of success Our nerous fine motor speed skills

The results accord closely with studies by Walker and Adams[5] and S Seashore[6] on knitting machinery, in both of which a battery of motor tests showed negligible predictive relationship to objectively measured complex practical skills Such continued demonstrations of the specificity and non predictability of individual differences in fine motor skills make it seem more profitable to direct further research toward the most effective methods of direct training in motor speed skills

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[5] R Walker and R Adams, "Motor Skills The Validity of Serial Motor Tests for Predicting Typewriting Efficiency," *Jour of Gen Psychol* July, 1934, 11, No 1, pp 173–186

[6] S Seashore, *Psychol Bull*, 27 p 653, 1930

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SCIENCE

VOL. 81 | FRIDAY, MAY 10, 1935 | No. 2106

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

WEISMANN AND HAECKEL: ONE HUNDRED YEARS[1]

By Professor A. FRANKLIN SHULL
UNIVERSITY OF MICHIGAN

THE human spirit in which there exists the spark of desire to commune with itself on any philosophical question needs only the breath of a round-numbered anniversary to fan the spark into flame. When it is blown upon by two such anniversaries, even if or perhaps particularly if from different directions, there may well be a conflagration. And when the vagaries of some organized body's activities happen to present to such a spirit the opportunity of communing with others of like mind to furnish intellectual tinder, the result would naturally be a holocaust. I give you fair warning, but trust it may not be needed. The American Society of Naturalists has agreed to devote its energies to fundamental biological matters and specifically names evolution as an example. If, when the society conferred on me the privilege and duty of making this address, it had had its eye on the calendar of the centuries, it could scarcely have failed to foresee what topic would be selected.

What form shall our commemoration of the birth of the arch selectionist and the arch genealogist take? Shall we eulogize them? That has been done recently for both in public or semi-public ways. Shall we criticize them and their views? That was done roundly in their active lifetimes in a manner which must have been regarded by them as quite ample. Shall we bring forth their chief doctrines, dust them off to give them a deceptive freshness and proceed to find in them the germ of all the essential modern views of evolution? That is much the commonest way of celebrating anniversaries. Such commendation was years ago bestowed on Weismann by an

[1] Presidential address delivered at the annual dinner of the American Society of Naturalists at Pittsburgh, December 29, 1934. Contribution from the Zoological Laboratory of the University of Michigan.

apostle who saw in the then still adolescent Mendelian principles as complete a confirmation of his theory of the structure of the germ plasm as its author could ever have coveted. I do not now recall any similarly enthusiastic appraisal of the Gastraea theory, but I would myself be inclined to accord its foundation, the biogenetic law, a higher seat at the banquet table of biological doctrines than is now the fashion to assign it.

None of these programs bids fair to lead to a correct representation of present-day thought concerning evolution. Moreover, none of them befits my temperament. I shall therefore eschew eulogy and condemnation, and refrain even from exposition of the contributions of the celebrated duo of evolutionists whose names we are now pronouncing with whatever reverence we severally feel toward them. Far more important to all of us is the present status of that branch of biological science in which they were almost pioneers. It has taken strides recently, of what length I am sure we do not all now appreciate, and I propose to use the great centenarians merely as a yardage sign beside the evolution fairway to see how far we have come. To gauge this progress involves contemplation of the historical development of certain features of the general concept.

One of the most wide spread characteristics of life is its adaptiveness. To many naturalists fitness is the one great attribute of organisms which needs and deserves explanation. In many quarters all else is secondary. Physiology and development are made to do anything, they are strained to the breaking point, and in justification of such distortion of their principles it is pointed out that only thereby can they be made to lead to utilitarian adjustment. Logic may be cracked if through the crevice thus created fitness to the environment may be revealed. Even the facts may be made to look different by gazing at them through glasses focused on the distant adaptation.

In the mind of the average biologist, theories of evolution are made or broken according as they explain or ignore, agree with or refute the common concept of adaptiveness. The strong appeal of inheritance of acquired characters not only to Lamarck but to modern adherents of the idea, is the easy explanation which it is believed to provide for advantageous adjustment to surroundings. The success of Darwinism was no doubt due in large measure to its obvious explanation of fitness. If it worked at all, it should explain adaptation, and it is probable that there were many who, reluctant to accept evolution itself without a *raison d'être,* did so in view of the ready solution of the adaptation problem which natural selection offered. Darwin's most ardent followers were of the opinion that all characteristics of animals and plants are useful, and were persuaded that the problem of the evolution of any given quality was solved when the service performed by that quality was pointed out. Many of the extravagances of evolution theory of the latter third of the nineteenth century—extended, I fear, into the twentieth—are directly due to this belief in the ubiquity of adaptation.

To these utilitarians the discovery of so-called mutations by DeVries must have come as a distinct shock. At least, the interpretation put upon these genetic changes by DeVries must have seemed like a sweeping away of the very rocks at the foundation of evolution. It will be remembered that most of the changes in Oenothera which the great Dutch botanist discovered were not gene mutations, and should probably not now be called mutations at all. They were changes involving chromosome arrangement and, as would be expected, affected many parts of the plant. The designation "elementary species" applied to these extensive modifications by DeVries suggested a similar origin of species in nature. When smaller changes which *were* due to changes of genes were discovered, the name mutation was naturally applied to them, and the same general significance in evolution was attributed to them despite their smallness. Thus, in the opening years of the present century some of our most eminent evolutionists were of the opinion that species arose through mutation, without necessary aid from any other process, and that natural selection was no longer an essential guide. Curiously enough, Bateson, one of the chief early discoverers of presumptive mutations in nature and later one of the greatest manipulators of mutations in genetic experiments, never saw in these changes the building stones of evolution. To his dying day, apparently, Bateson was unable to picture the formation of species as occurring through the accumulation of mutations. His rejection of them however, had nothing to do with their usefulness. Bateson set no great store by the adaptiveness of evolution. He was even one of the great critics of the school of selectionism which flourished, and still flourishes, in his own country. His dismissal of mutations as evolutionary changes rested upon their nearly universal fertility with their parent types. How, he asked, could species, which are usually intersterile, arise from a common stock through changed individuals which were at every step fertile with one another and with their parent types? The answer to his question we are perhaps in possession of now, but it must await its turn.

The experiments of Johannsen with selection in pure lines, and those of Jennings in clones were generally regarded as confirming the conclusion that natural selection is superfluous. Why they should have been so may now seem an oddity, since the experiments as a whole were not only in harmony with natural selection but actually proved the existence of

mixtures of genetic entities which is precisely the foundation on which selection must work But even only three decades ago, to the average biologist variation was still variation It is vain to point out, as is frequently done, that even Charles Darwin knew that some variations are inherited, others not Nothing is more common than that a worshiper should seize upon some saying of his deity to prove that all knowledge, including that which is generally considered recent, was already his A well known entomologist, still living, heatedly declared that Johannsen's genes were nothing more than Darwin's gemmules, overlooking the two important facts that gemmules multiplied in the cells and were transported, neither of which things the genes do No, with all due honor to Darwin, it can hardly now be maintained that he distinguished two classes of variations Certainly he did not recognize a distinction based on fundamentally different origins It is possible, moreover, to see in Darwin's admission that variations are sometimes not inherited a belief that the very same variation occurring at another time might be transmitted Much of this early amalgamation of variation into a single phenomenon still existed in the early years of this century Under its influence, the failure of selection experiments to produce changes in the direction of selection was regarded as another blow to the theory of natural selection

Had evolutionists at that time looked away from the negative results of the selection experiments and looked at the positive effects—had they turned from the failure of selection within pure lines and clones and fixed their attention on the demonstration that unlike pure lines and clones exist together in populations apparently homogeneous—they would have sensed more correctly the real significance of those experiments, and would have reversed their conclusions regarding the effectiveness of selection A glimpse of what might have been deduced from the pure line and clone experiments was afforded by the experiments of Castle on hooded rats The sorting, sifting action of selection was there fortunately seen at work upon the only kind of variation which can lead to evolution Mendelism was, moreover, older by that time Variation of a quantitative and apparently continuous type was soon thereafter seen to be as truly Mendelian as the simple sharply defined steps Many intricacies of gene interrelationships were revealed, and the Mendelian system, which in the early years after the 1900 discovery was freely stigmatized as too simple to be true, was now growing too complex to be true

It is ofttimes now regarded as strange that the new knowledge of genetics did not earlier influence evolution theory Every writer discussing the general field of evolution recognized that transformations of species involved heredity, and every such writer described the simple genetic processes and the mechanism on which they rest But for many years not one of them attempted to show even approximately how evolution must proceed as a consequence of the operations of that mechanism In explanation of this neglect it need hardly be pointed out that a mathematical mind and training are prime requisites to delving into the evolutionary processes dependent thereon Fortunately, these essentials are now provided in company with masterful attainments in the purely biological field, and at the hands of Wright, Fisher and Haldane we are gradually being shown what the course of evolution must be in the light of the Mendelian mechanism We have learned what may happen to gene ratios without any particular cause, what should follow any definite schedule of mutation, particularly of repeated mutation, how migration affects the genic composition of a species, what consequences must flow from any selective advantage or disadvantage of any gene or collection of genes, in what manner the expected results are modified by the size of the population, and the very considerable differences in some of these influences depending on whether the population is growing, stationary or declining It is already plain that there is much in evolution which most of us had not heretofore suspected

Let us pause to congratulate ourselves upon our accomplishments I proposed a moment ago to use the great evolutionists born a century ago and actively championing evolution and its supposed factors half a century ago as distance signs to measure our progress Having taken our drive and located the evolution ball approximately in its present lie, let us pace off the distance beyond our markers We find Haeckel tracing pedigrees, and not greatly concerned with causes Weismann, firmly convinced of the correctness of the selection doctrine, was applying it to a wide range of animal characteristics Indeed, it was to him universally applicable, since all qualities were apparently held useful In furtherance of their individual fortunes, animals were held to have resorted to all sorts of ingenious devices—almost as ingenious as the theories of the evolutionists who were capable of detecting them Their colors and shapes changed to render them inconspicuous to man, no questions being asked about their visibility to their real enemies Ornaments arose in them in response to the love of beauty in one sex when no other evidence of the esthetic sense existed Strikingly gaudy patterns and blatantly obvious shapes sprang up to proclaim from the housetops with clarion silence the possession of a disagreeable taste or means of attack which ofttimes was not, from any other source than the warning, known to exist. Many a species was

held to have taken advantage of these danger signals to steal an unearned immunity from the predatory world by imitating those which gained a freedom from attack by direct methods To this time also belongs the discovery of the defenseless animals whose mean individual psychological attainments entitled them to the once common designation "bromides," and which in keeping with these qualities invented the modern game of 'follow the leader," and developed conspicuous marks on their hinder parts To the spirit of that time, even if later in actual years belong also the bogey colors, and we find it seriously proposed even in the latest edition of one of the great cyclopedias that a two inch fulgorid bug owes its particular color to the advantage of resembling a crocodile But I must end this recital of examples, lest you suspect I have inadvertently confused my dates by a few months and that it is really the centennial of Mark Twain which we are celebrating

Truly we have come a long way I fear, however, that the spirits of the preceding generation of evolutionists must be disappointed in us We have progressed much more slowly than they evidently expected we would, and have taken a very different road For Romanes, writing in the early nineties of the last century, shortly before his death, and advocating not only the Darwinian selection but the Darwinian inheritance of acquired characters as well, expressed the firm conviction that another ten years would see all outstanding difficulties in the way of evolution theory removed, and an era of good feeling inaugurated in which all evolutionists would be of like mind This forecast reminds one of that other justly famous prediction of an artificial basic evolution, a wager laid at the turn of the century between an eminent physiological chemist and a celebrated cytologist, the stake being the best hat in New York City, that protoplasm would be created in the laboratory within ten years Again we have failed in what was expected of us It seems that in biology even Ten Year Plans have a habit of lagging behind schedule

In view of the great expectations indulged in by biologists of a few decades ago, perhaps we owe ourselves a measure of justification Is not our slowness really a consequence of our predecessors' speed? Have we not had o clear away endless corduroy, running crosswise and leading nowhere, before we could build the permanent pavement in a forward direction? Is there not even now a great deal of energy spent in hewing logs to repair the corduroy which might be spent in mixing concrete for the new highway? It would not be difficult to maintain that our present views of evolution would be sounder if there had been no direct study of it—certainly if there had been no speculation upon it—from the publication of "The Origin of Species" down to 1910 or even 1920 This is probably true of many great developments The historical order is not the logical nor the economical one The foundation facts on which a correct evolution doctrine must rest would have been sought—were sought—more for their bearing on physiology, genetics and embryonic development than for their relation to evolution Hence the absence of evolution speculation would have removed no stimulus necessary to progress toward a correct solution of evolution problems

These comments are made, not with any belief that the rugged individualism of science by which any one was free to follow any whim and propose any theory could have been replaced by a new deal wherein only directed effort would be permitted, but only to explain our delay in arriving at sound results It was inevitable that easy speculation should have been preferred to experimental search for principles Little else than speculation was at the foundation of the theories of warning color, mimicry and signal colors, for example Supposed evidence for them of an observational sort was garnered from hither and yon with all the nonchalance of the smoker of a well advertised brand of cigarettes The colors of animals are no more marvelous if left unexplained than are the theories advanced to account for them They are no more wonderful than is the ingenuity of man in explaining them If we could explain the evolution of the human imagination we would have a better understanding of the theories named than we can get now

The danger from most theories is the heavy hand they lay on subsequent workers Fisher, one of the leading exponents of the new approach to natural selection, refers to mimicry as "the greatest post Darwinian application of natural selection" This remark is the reason for my perhaps unwarranted attention to these theories of color Its truth or error probably hinges on the meaning of one word in it The saving or damning ambiguity of the word "greatest" is that it may refer to magnitude measured in decibels rather than in pounds I do not know the meaning attached to it by the author of the statement I am reluctant to think that his valuation may be only an example of nationalism in science, though I can scarcely imagine it coming from a leader of an important modern biological movement in any intellectual country but one I often wonder what scientific foibles we subscribe to in America because of a magnetic personality, powerful leadership or affable volubility There must be some

What does one do with a misapplied theory? Biologists have answered variously The biogenetic law has been completely rejected in some quarters because the specific events which it was used to explain were

erroneously chosen Even those who reject it admit the correctness of a modified form of the theory One of Mendel's laws was found to be violated by linkage But was it rejected *in toto*? No, it was modified to include all chromosome behavior Natural selection, at the end of the last century, was judged—and still is judged by some—from the applications of it made by its supporters, and was by many able biologists rejected The trouble with the natural selection theory is not that it will not work, but that it will not accomplish the results attributed to it The germ theory of disease does not fall down when a mistake is made concerning the identity of the causative agent of a particular malady It is even possible that the Nobel prize in medicine might be awarded for a discovery which proved later to be an error What theory—what valid theory—is there that has escaped this fate of wrong application?

Merely to use a great principle to wrong ends is the simplest and least harmful of the untoward events that can happen to it Such a principle might even be distorted to a considerable degree and still be worth rescuing, rehabilitating and recognizing by name It is already evident that this is to be the destiny of natural selection There are still some to whom natural selection means the explanation of a host of supposedly advantageous small characters which was the occupation of Darwinian supporters of a generation ago, some of whom still live To these few, the word "selectionists" is still used to mean essentially the explainers of animal colors It is a hopeful sign, however, that capable biologists have been able to approach the whole question of selection again in a semi abstract form with no particular qualities in mind as needing, above all things else, an explanation If architectural details can be forgotten for a time while sound plans dealing only with stresses and strains and strength and resistance of materials are evolved, it is likely that we may emerge with a practical and at the same time harmonious edifice We may thus acquire a doctrine which, unlike the portmanteau theory derided by Yves Delage as capable of yielding up only what was put into it, will resemble more the magician's hat or the widow's cruse in dispensing far more than was first assembled in it—will indeed bring forth more than hopeful enthusiasm ever imagined it to contain But this will not happen in ten years.

Having thus congratulated ourselves upon the magnificent distance of our drive, let us return to address the ball for the next stroke Let it be borne in mind that our present position is not the result of a second shot starting from mimicry, sexual selection and similar concrete proposals That ball was lost Our recent drive started afresh from an alternative tee, namely, genetic phenomena The club used is fashioned along fundamental Mendelian lines We recognize that evolution consists of changes in the nature or arrangement of genetic units These units are with few exceptions chromosomally contained, the known exceptions being certain plastid characters A certain influence of cytoplasm upon early development has often been hailed as evidence that fundamental race characteristics are determined by the general protoplasm, but there are several indications that even this cytoplasmic influence comes under the control of genes within a generation The genes in bisexual animals recombine in a fairly free way every generation The restrictions imposed upon this recombination by inclusion of many genes in a single chromosome are rapidly removed by crossing over, so that in a long time project like evolution they may be ignored The genes may change, and change again, and return to any of their former states Since evolution deals with populations, migration into and out of any group may change its composition Relative proportions of the alternative genes in a collection of individuals determine the nature of the population, and these proportions are modified by the accidents of recombination, accidents of survival, changes in the genes and the accidental wanderings of individuals If any gene or combination of genes confers an advantage that is expressed in increased relative numbers of descendants—and no other advantage is an advantage in evolution—that gene or combination gains over its alternates A gene in one setting of accompanying genes and environment may have one effect, but in another setting a very different effect The interplay of all these factors results in evolution so far as it depends on the regular mechanism of Mendelian heredity

Using these fundamental features of the evolution mechanism Wright, Fisher and Haldane have formulated the expected consequences of each factor under various suppositions They have postulated mutation rates, including reverse mutations migration rates, selective advantages and various population sizes and out of them have pictured the evolution process in the abstract Along with this service they have performed two others of which they may not have been aware Their mathematical treatment has served to take evolutionists out of themselves, to make them less introspective, to force them to look for factors of evolution outside of their own minds, which is where most of them have been looking heretofore It has also helped to develop an inferiority complex where one was badly needed but never before existed While their mathematical discussions are frequently summarized in plain language, there are many parts of them which impress a non mathematical person with his own incapacities They show that many means of acquiring a valid opinion are closed to such a person.

How immensely valuable it would have been to the whole structure of evolution theory to have had such treatises circulated among naturalists just when the theories of animal coloration for example, were being promulgated! How our friends the economists and psychologists must envy us now the possession of one small means of reducing the number of those who feel qualified to speak!

The debt we owe to our mathematical minded friends is obvious. Any one who acknowledges that two and two make four should recognize this obligation, even if he does not follow their reasoning. So great is our debt to them that it would be ungrateful not to point out any shortcomings we think we see in the purely biological assumptions they make. It was Johannsen I believe who adjured us to treat our biology not *as* mathematics, but *with* mathematics. None of these leaders is under the illusion that statistical methods alone will solve all evolution problems, but it is easy to argue from mistaken premises. This I think at least one of them has done.

An error of a purely biological sort I deem to have been made by Fisher relative to the direction of mutation. If mutation is the beginning of every evolutionary change, obviously evolution can not proceed in a direction in which no gene changes. Fisher plainly assumes that mutation is purely random with respect to direction. When he merely states that mutation is random, it would be possible to suppose that he means fortuitous as to time or locus. This can not be all that he does mean however for his philosophy of evolution requires in several respects that mutation be random as to quality as well. Ford, who has been associated with Fisher in some evolutionary projects and who apparently takes his statistical cue from the latter is more specific, and claims explicitly that mutation is purely fortuitous in quality (that is, in the nature or direction of the changes) as well as in locus. It would be easy to imagine that support for this assumption has been given by competent geneticists when really they offer no such corroboration. Muller for example, points out that mutation is random but means thereby only that it is non adaptive, that its nature is not determined by the environment. Fisher's assumption clearly is that mutation is happening, not just in every *possible* way (the possibilities being limited by the structure of the genes), but in every *conceivable* way. He holds that mutation provides *every* avenue of progress and that something chooses among the radiating paths. That thing he holds, as do we all with less sweeping premises, to be natural selection. Whether his belief in the randomness of direction of mutation has led him to his faith in the Allmacht of selection or whether his conviction that selection is all powerful moved him to conclude that mutation must be random in quality is uncertain. The two are closely bound, and their adoption by Fisher constitutes, in my opinion, one of the weaknesses of his position.

There are many reasons to conclude that mutation is not random in quality, but is directed. This does not mean that a mutation occurring at a particular time and place must be of only one sort, though it is conceivable that even this might be true. Still less does it mean that successive mutations at the same locus are likely to go farther and farther in the same direction, though even this has been held probable by at least one geneticist. It means merely that some of the conceivable paths, probably most of them, indeed, are closed. The repeated occurrence of certain mutations, like that to white eye in Drosophila, is an indication of such guidance. So is the production of parallel mutations in related species, as the occurrence of ruby eye and a number of other mutations in two species of Drosophila or a number of color mutations in mice, rats, rabbits and guinea pigs. It strains one's faith in the laws of chance to imagine that identical changes should crop out again and again if the possibilities are endless and the probabilities equal. Reverse mutations would be very unlikely if the direction of mutation were purely random. Were eye color mutations random in quality, every color in the rainbow should be represented. The fact that in Drosophila many shades of red have arisen, while not once has there been a mutation to green or blue, leads to a suspicion that for some reason these latter colors are impossible. All this limitation is rendered *a priori* very probable by the fact that genes must be chemical entities, and that no chemical substance is capable of reacting in every conceivable way. To assert, as Fisher does, that mutation has nothing to do with the direction of evolution is like assuming that a tetrahedron may fall, at different times, with ten or a hundred points uppermost. The ten points and ten opposite sides to fall upon do not exist. How great a restriction is placed upon the course of evolution by the inability of genes to mutate in certain ways it is impossible to tell, but it may easily be much greater than any of us suppose.

A logical consequence of the belief that mutation is wholly random in quality is the conclusion that species change promptly and perhaps rapidly in that direction in which their own best interests lie. If mutations really do occur in every conceivable direction with equal probability, and some of them confer advantages, there can be no reason why a species should not start at once in one or more of the favorable directions, at a speed dependent on the frequency of mutations in those directions and the degree of advantage afforded by them. Thus, a species should at any moment be about perfectly adapted to its environment. And, indeed, we are told that this is what

expect Alas! When I reflect that, under i's orders, I must forever refrain from the ities of apple pie, I am reluctant to believe inisms are as well adapted as they might con be And if I am reminded that the defect have cited is that of an individual, not of a I need only add that if I were making a race perfectly adapted to its environment I certainly wish to endow it with an enzyme that would digest cellulose It seems clear to me that species are not probably in any instance, as well adapted to their environments as they could be They may be approaching as close an adaptation as is permitted by the mutations arising in them, but that must fall far short of perfection For every living kind this best of all possible worlds must yet have room for improvement

Fisher has adopted views of the origin of and reason for dominance with which Wright and Haldane are unable to agree In so far as his opinion rests on the assumption that genes produce different effects, depending on the company they keep, it is well enough grounded But the smooth working of the scheme of growing dominance demands again a steady flow of random—qualitatively random—mutations The mere fact that wild type genes are so generally dominant over their mutants indicates that, if Fisher's theory of becoming dominant through accumulation of accessory genes which increase dominance be correct, this accumulation must occur relatively rapidly That is, genes of the right kind must always be quick to appear, no matter what is demanded of them This could only happen if genes of every conceivable kind were appearing with what must be considered, in evolution, great frequency and regularity

This concept of gradually changing dominance is probably responsible, at least in part, also for Fisher's sliding scale of gene effects He states that if a change of 1 mm in some quality has selective value, a change of 1 mm in the same quality and in the same direction will have approximately one tenth as great selective value When I read this statement I recall that I, as a boy at the county fair, strove with mighty blows to lift the heavy weight until it rang the bell, but never succeeded I could get three fourths or even nine tenths of the way Had I held Fisher's philosophy, I should have demanded three fourths of the Negro doll which was the reward of success, but I would have been denied In living things, just as in carnivals, there are thresholds which must be reached before any effect is produced The new philosophy of natural selection has not abolished them They exist in development, in general physiological processes, and I doubt not in adaptation

We have here a group of more or less related situations in which a wrong reading of biological facts may easily lead to wrong conclusions, despite the most careful of mathematical calculations I yield to no one in my satisfaction in the progress recently made in attacking evolution over the mathematical route But we should be exceedingly careful to base the calculations upon sound biology

At still another point on the new battle front is there need of consolidating our positions In the late war, when an official bulletin described the activities of the military as a consolidation of its gains, it meant that the army had retreated Perhaps that is what is needed in the present evolution skirmish, at least in certain places The consolidation is needed in our attitude toward the origin of those qualities which have no value I know that I shall be challenged concerning what I am about to say, but I do not entertain any doubt whatever that living things are possessed of characteristics that are of not the slightest use In an ordinary assembly I might defend this position by illustrating it only from mankind, and asking my hearers merely to look about them for examples Before the American Society of Naturalists, however, it seems necessary to go afield and refer to species in general

Most systematic workers appear to be convinced, at least with respect to the groups with which they are familiar, that the differences between nearly allied species are chiefly useless distinctions Students of animal color, particularly of insect color, should take notice They are prone to claim a use for specific distinctions in color in view of the apparent non adaptiveness of other species differences, however, it is far safer to acknowledge usefulness of color only after the most complete proof of it has been obtained

It is these useless characters which constitute one of the puzzles of evolution They are a particularly heavy load upon the natural selection doctrine Nor are specific characters the only ones that fall in the seemingly non-adaptive class Many great evolutionary developments in the past give every indication of having been without advantage, such as the curious armatures of some of the huge mesozoic reptiles and some of the extinct mammals So numerous are the apparently useless characters of organisms and the ostensibly non adaptive changes in them that most evolutionists have felt obliged, at one time or another, to postulate some other factor besides natural selection to account for them Could such a factor be discovered and be proved general most of the outstanding problems of evolution would be started on the way to solution What the world most needs, then, is not a good five cent cigar, but a workable—and correct—theory of orthogenesis

Unfortunately the Lamarckian principle that the

need of or desire for a thing helped to bring about its development does not apply to biological theories any more than to animal characteristics, and no acceptable theory to account for wide spread non adaptive evolution has ever been devised Of the leaders of the statistical movement in the study of evolution, only Fisher seems oblivious to the need of such a principle, perhaps because he recognizes only a very small minimum of useless qualities Wright is fully cognizant of the abundance of non adaptive characters, and allows accident to explain the smaller examples, up to the level of varietal or even specific differences He is aware, too, that much more than this is needed Haldane is conscious of his possible ignorance in this small field of evolution inquiry, namely, the adaptiveness or non adaptiveness of specific differences, but has made a brief but serious attempt to give an explanation to orthogenesis He suggests that the genes producing the useless adult character may have a selective advantage in the embryo Certainly no general theory of evolution can go unchallenged which does not permit the origin of unadaptive characters I wonder whether the mathematical possibilities of non adaptive evolution have been as thoroughly explored as they may be I trust that the ray of hope which formulas, curves and equations have given us has not emitted its last flicker in this particular direction

While waiting for possible further developments in the statistical field we need not stand idle Some of the most significant of evolutionary changes appear at present not to be amenable to mathematical study Their exemption from statistical formulation derives first from their infrequent occurrence (and statistics is ever based on considerable numbers so that random opposite effects may tend to cancel one another) and second from the uncertainty whether they are wholly accidental To shorten the discussion I shall pass by, despite their importance, the very quick transitions from one species to another, not through gene mutation and shifting of gene ratios, but by polyploidy, discovered so much more abundantly in plants than in animals I shall likewise omit consideration of interspecific hybridization as a means of attaining recombination of genes

It is rather to the isolation of species from one another that I shall turn for what seems to me some of the most significant of recent advances For isolation has been in the past as far from a satisfactory explanation as any other major phase of evolution, excepting only non adaptive modification Though geographic isolation was first in the minds of evolutionists who realized the importance of insularity of groups in the development of differences between them, it has played little part in the new forward strides toward a knowledge of the segregation of species It seems now a little odd that separation ever should have been relied on so many of the differences that were observ ist between closely allied species True, it ai group in experiencing a different series of gene ratios, and could easily have brought a visible distinctions between species What not do, in accord with anything then known o ity, was to produce the sterility, partial or co which nearly always arose between such groups along with their visible differences This sterility was not lightly to be dismissed So characteristic of species is their sterility with other species that the late Professor Bateson was ready, as already pointed out, to reject mutations as the building stones of evolution because every known mutant could be crossed with its parent type with resultant fertile progeny How could intersterile species arise out of interfertile mutations? It was of course conceivable that differing aggregations of genes would entail a reduction of fertility if brought together Something is known to day of combinations of genes that induce sterility between types, but these are genes whose only known effect is that upon fertility, and it is combinations of these particular genes, not combinations of general gene complexes, which cause incompatibility of gametes or infertility of zygotes But even if there had been some plausibility in the assumption that accumulation of gene differences of any sorts whatever would gradually lead to intersterility, evolutionists of the period to which we are looking back should have been cautious in attributing sterility to geographic isolation, for they found the same sterility to exist between types for which there was no apparent reason for geographic separation They frequently took refuge in the belief that geographic isolation existed where none could be seen, but imagining barriers where none was apparent was as objectionable a procedure as hypothecating anything else merely to save a theory

Although a master key to the problem of interspecific sterility has not been found, at least one individual solution and several clues have been discovered, none of which bear any relation to environment Geographic barriers may exist, but they are not necessary to the separation of taxonomic entities And the search is rightly being made among genetic phenomena and their related cytological events.

Only a little while ago there was a strong hope that abundant sources of intersterility would be found in the phenomena of meiosis, knowledge of which is itself but little more than a generation old Organisms have solved the problem of approximate stability of type, coupled with a degree of genetic plasticity, by adopting, along with gamic reproduction, the synapsis of homologous chromosomes fol-

lowed by their regular separation in the formation of the gametes. This method insures the viability of by far the majority of all combinations, in place of the chaos and excessive mortality which must occur in the absence of any such scheme. Yet it provides slow change through random recombination of chromosomes as groups, and fairly rapid reconstitution of individual chromosomes through crossing over.

Into this mechanism there creep occasionally such changes as inversions, duplications and translocations—rearrangements of genetic material without any necessary changes in its units. These irregularities were eagerly studied in the search for causes of intersterility. For, since the rapprochement of homologous chromosomes in each generation is apparently due in large measure to the similarity of the genes they contain and of the arrangement of those genes in the chromosome, the occasional changes in this arrangement just referred to might reasonably be expected to prevent much of the usual synapsis, with consequent irregularities of meiosis, and deficiencies or surpluses of genes in the several gametes. Some loss of fertility would naturally follow each such irregular event. It was conceivable, however, that among the products of the irregularity two similarly disarranged chromosomes might have the good fortune to meet in fertilization, along with the usual (or some other viable) combination of the remaining chromosomes, and a new type to be the result. Such a type might differ little or not at all from the original, yet it seemed plausible that there should be a degree of infertility of their hybrids because of the unmatched constitution of their chromosomes.

I speak of these discoveries in the past tense and subjunctive mood because there is now considerable doubt of the efficacy of the disarrangements of chromosome parts. The only well known species in nature differing chiefly by an inversion are two species of Drosophila, and though their hybrid is sterile as expected, that sterility is evidenced by degeneracy of the reproductive system at a time too early for synapsis. Likewise, the best known translocations have not led to sterility of hybrids. The outlook for an explanation of intersterility as a consequence of chromosome aberrations is thus somewhat dimmed, though it can hardly be said that the possibilities have been explored and the method should not be abandoned as useless until more instances of its inadequacy are known.

No great despondency need descend upon us, however, because of the failure of such obviously possible explanations of intersterility to meet our early expectations. We have left to us the sterility genes which have been most carefully studied in various relations within species. All that is needed is to extend these relations to crosses between species, and to postulate dominant complementary genes, each existing harmlessly in one species but blocking some essential reproductive process when together with another in the same individual, as in the species hybrid.

Regardless of the nature of the cause of sterility of hybrids, once such a mechanism is in existence in two individuals or groups of individuals, all that is necessary thereafter is that different mutations shall occur in the two types—mutations which can not be transferred from one to the other by hybridization—and two species are distinguishable. These things are well known, I think, to all of you, but their significance has not yet crept into the consciousness of the evolution fraternity in general. Their possibilities with reference to the isolation of species are endless. Moreover, so spontaneous may they be that sterility between types may spring up anywhere. No longer do we need to postulate a considerable divergence of types before intersterility arises. Sterility may originate early in the process of separation or even before any other modification commences. It may be and probably is one of the primary reasons for the splitting of species, since any changes that do arise by mutation or otherwise are thereby removed from some of the leveling influence of hybridization. If this surmise is correct, there may be hosts of incipient species about us, differing in no observable respect from other members of what is still called their species, but possessing already the quality which renders them incapable of breeding with certain of their fellows. Whether these partially isolated groups survive the accidents of elimination, the chances of breeding with those with which they still are fertile and other factors of preservation are other questions which may now be regarded as secondary.

We have arrived at our destination, namely, the present day concept of evolution. At least we have approached as near that goal as the guide is licensed to conduct parties. We have traveled laboriously, and naturally look back upon the distance traversed with satisfaction. We may assume a supercilious attitude toward our predecessors, and view their evolutionary ideas with scorn. Their theories may seem to us conceived in romanticism, and their arguments to be a cobweb of irrationality. In the words of a popular writer, on whom I tried out the general drift of this address before bringing it to you, we may regard their period as one of bewilderingly obfuscatious scientific hallucination, abbreviated in this day of governmental alphabetics to BOSH. But even though this judgment were correct it would little behoove us to harbor it. Far more important than to congratulate ourselves upon our accomplishments is to acknowledge how much is still undone. While I am quite unwilling to share with Osborn, Barbour and some others the view that we are still as ignorant of

the factors of evolution as biologists were a generation ago—a few biologists may still be—I am quite certain that even a moderately full knowledge of them is still far beyond Even were the only outstanding difficulty the existence of non adaptive qualities in organisms we should be still far from finality, but this I regard as the heaviest task before us The alternative of this task, which has sometimes been proposed, namely, a denial that any evolution is non adaptive, is not to be considered until every other possibility has been thoroughly explored For most of us a time which is ripe for such denial will never come, for the necessary explorations of other leads can not possibly be made in many times ten years

SCIENTIFIC EVENTS

THE TWENTY-FIFTH ANNIVERSARY OF THE BROOKLYN BOTANIC GARDEN

INVITATIONS and announcements have been issued for the celebration of the twenty fifth anniversary of the Brooklyn Botanic Garden from Monday to Thursday, May 13 to 16 The programs fall under four headings—civic, social, scientific and educational

On Monday evening the president of the board of trustees, Edward C Blum, will preside The speakers include the president of the borough of Brooklyn, the Honorable Raymond V Ingersoll, the commissioner of parks the Honorable Robert Moses, the president of the board of education, the Honorable George J Ryan, and the chairman of the Botanic Garden governing committee, Miss Hilda Loines The principal address will be given by Dr Albert F Woods, director of the Graduate School, U S Department of Agriculture The program will be followed by a reception and inspection of exhibits illustrating the progress of development of the Botanic Garden since 1910 A feature of this exhibit of special scientific interest will be a selection of some of the incunabula and other rare books and manuscripts in the Botanic Garden library

On Tuesday afternoon the twenty first annual spring inspection of the garden, with the Honorable Fiorello H La Guardia, mayor of New York, as guest of honor, will be held This will be in charge of the woman's auxiliary of the garden

The scientific programs deal with the progress of various aspects of botanical science during the past twenty five years, as follows

Wednesday Morning Presiding, Professor R A Harper, Columbia University

(1) "Virus Diseases of Plants Twenty five Years of Progress, 1910–1935 " Dr L O Kunkel, Rockefeller Institute

(2) "Twenty five Years of Cytology, 1910–1935 " Professor Charles E Allen, University of Wisconsin

(3) "Twenty five Years of Genetics, 1910–1935 " Dr Albert F Blakeslee, Carnegie Institution of Washington

Wednesday Afternoon Presiding Professor Edmund W Sinnott, Barnard College

(1) 'Twenty five Years of Plant Physiology, 1910–1935 " Professor Rodney H True, University of Pennsylvania

(2) "Light on Vegetation, 1910–1935 " Dr John M Arthur Boyce Thompson Institute for Plant Research

(3) "Twenty five Years of Ecology 1910–1935 " Dr H A Gleason, New York Botanical Garden

(4) 'Twenty five Years of Forestry, 1910–1935 " Dean Samuel N Spring, New York State College of Forestry, Syracuse University

Wednesday Evening Presiding, Dr William Crocker, Boyce Thompson Institute for Plant Research

(1) 'Twenty five Years of Plant Pathology, 1910–1935 " Professor L R Jones, University of Wisconsin

(2) 'Twenty five Years of Systematic Botany, 1910–1935 " Dr Elmer D Merrill, New York Botanical Garden

(3) "Twenty five Years of Paleobotany, 1910–1935 " Dr G R Wieland, Carnegie Institution of Washington

(4) Motion picture (silent)—"The Life Cycle of a Fern " Harvard film Premier showing

Thursday morning will be devoted to a horticultural program, with John C Wister, director of the Arthur Hoyt Scott Horticultural Foundation, Philadelphia, presiding The papers are as follows

(1) "Twenty five Years of Horticultural Progress, with Special Reference to Foreign Plant Introduction, 1910–1935 " Dr W E Whitehouse, U S Department of Agriculture

(2) "Opportunities for Women in Horticulture, 1910–1935 " Dr Kate Barratt, the Swanley (England) Horticultural College

(3) "Growing Plants in Sand with the Aid of Nutrient Solutions With Special Reference to Practical Applications " Professor C H Connors, Rutgers University

(4) "Modern Methods of Plant Propagation " Dr P W Zimmerman, Boyce Thompson Institute for Plant Research

(5) "Plant Patents " Colonel Robert Starr Allyn, deputy commissioner of sanitation, New York City

(6) Motion picture—"Naturalized Plant Immigrants " U S Department of Agriculture, Bureau of Plant Industry

The Thursday afternoon program will be given to

botanical education, including elementary education The papers are as follows

Presiding Dr John S Roberts, associate superintendent of schools, New York City

(1) "Botanical Education for Young People" Dr D W O'Brien, the School Committee of the City of Boston

(2) "Twenty five Years of Botanical Education, 1910–1935" Professor Otis W Caldwell, Columbia University

(3) Motion picture—"How Seeds Germinate" U S Department of Agriculture, Bureau of Plant Industry

The first program on Thursday evening will be devoted to adult education in botany and the newer techniques of education developed since the Botanic Garden was established

Presiding Julius M Johnson, president, the New York Association of Biology Teachers

(1) "Adult Education in Botany" Dr Loren C Petry, Cornell University

(2) "Radio in Botanical Education" Morse Salisbury, U S Department of Agriculture

(3) Motion pictures—"Their Part in American Education" Dr Clarence E Partch, Rutgers University

(4) Demonstration of silent "movies" and "talkies" (a) "Time Lapse Studies in Plant Growth"—1 reel, U S Department of Agriculture film (b) "Plant Life" (a sound film)—1 reel, Harvard film service

There will be an invitation buffet luncheon on both Wednesday and Thursday, a tea on Thursday afternoon in charge of the Junior League of Brooklyn and informal receptions with inspection of the exhibits on both Wednesday and Thursday evenings The hostess on Thursday evening will be the Garden Teachers Association of the Botanic Garden Members of the Boys and Girls Club of the Botanic Garden will also assist throughout the week

On all days there will be opportunity to inspect the plantations and collections under guidance All persons interested in botanical science and education are invited to attend the Wednesday and Thursday programs

EXPEDITIONS OF THE SMITHSONIAN INSTITUTION

THE results of twenty expeditions sent out last year by the Smithsonian Institution are described in a report recently issued Collections of biological, geological and anthropological specimens for the U S National Museum were made in China, Siam, Mexico, South America and the Galapagos Islands, as well as in the United States and its territories

Dr Charles G Abbot, secretary of the institution, and L. B Aldrich, of the Astrophysical Observatory, conducted an expedition of two and a half months' duration to Mount Wilson Calif, where extensive astrophysical work was conducted Throughout the year daily observations of solar radiation were made at the stations at Table Mountain, Calif, Mount Montezuma, Chile, and Mount St Katherine in the Sinai Peninsula

The Rev David C Graham, in the high mountain regions of the Szechwan Province of China, made natural history collections, obtaining such rare animals as the golden haired monkey the giant panda, the blue sheep, the horse-tailed deer and the Chinese red wolf Dr Hugh M Smith, associate of the institution, formerly fisheries adviser to the Siamese Government penetrated the wild country at the head of the Pasak River He made there collections of rare birds and several new species of fishes Dr W F Foshag hunted rare minerals in the Sierra Madre Mountains of Chihuahua, Mexico, and in other Mexican mining districts. Dr C Lewis Gazin sought the bones of extinct animals in the Snake River basin of Idaho and in one place obtained the skulls of about sixty five ancient horses Studies of ancient fauna in southwestern Ontario and in Michigan were carried on by Dr G A Cooper, assistant curator of paleontology, who was associated with Dr A S Warthin, of Vassar College Their researches enabled them to construct a partial, tentative picture of the country during the Devonian period.

Dr Waldo L. Schmitt, curator of marine invertebrates, represented the institution on the Galapagos Island expedition of Captain G Allan Hancock An exceptionally rich natural history collection was obtained, including ten species of poisonous sea snakes A study of the butterflies of Virginia was undertaken by Austin H Clark, curator of echinoderms About 8,000 specimens of grass, including some rare species, were obtained by Jason R Swallen in the mountains of Brazil C W Bishop, assistant curator of the Freer Gallery of Art, carried out an archeological reconnaissance in China over an area approximately 500 miles in length by nearly 200 in breadth Dr Aleš Hrdlička, curator of physical anthropology, continued his excavations on Kodiak Island, Alaska where he found evidence of a great prehistoric massacre

Archeological projects were conducted in the valley of the lower Columbia River by Herbert W Krieger, curator of ethnology, in Florida by CWA workers under the direction of Matthew W Stirling, chief of the Bureau of American Ethnology, on the Shiloh battlefield by Frank H H Roberts, Jr, and in California by William D Strong and Winslow M Walker Dr John R Swanton reports progress in tracing the

route of De Soto through the southeast, Dr John P Harrington continued his researches among the Indians of California and Dr Truman Michelson studied the Passamaquoddy Indians of Maine

THE EXPOSITION OF CHEMICAL INDUSTRIES

THE fifteenth Exposition of Chemical Industries will be held at Grand Central Palace, New York, from December 2 to 7 It is said that it will be one of the largest in recent years, and that the volume of requests for space makes necessary the early preparations which are being made for this year's show Some of the more pretentious exhibits are being designed and constructed over a period of eight to ten months in advance of the exposition week and companies leasing the smaller exhibition spaces are making their contracts many months in advance At the last exposition, held in 1933, the attendance was from 983 cities and towns in 42 states of the United States and from 69 cities and towns in 27 foreign countries The registered attendance was 34,269, representing an increase of 50 per cent over the previous exposition Admission is without charge and by registration or invitation only No tickets are sold

The Exposition Advisory Committee will include distinguished representatives from all the leading chemical organizations

Members of the Advisory Committee are as follows A D Little, Arthur D Little, Inc *chairman,* Raymond F Bacon, consulting engineer, L H Baekeland, honorary professor, chemical engineering, Columbia University, Wm B Bell, president, Manufacturing Chemists Association, J V N Dorr, president, the Dorr Company, A E Marshall, president, American Institute of Chemical Engineers, Henry B Faber, consulting chemist, John M Alverez, president, Salesmen's Association of the American Chemical Society, Williams Haynes, president of Chemical Industries, Charles H Herty industrial consultant, H E Howe, editor, *Industrial and Engineering Chemistry,* James H Critchett, president of the Electrochemical Society, Sidney D Kirkpatrick, editor, *Chemical and Metallurgical Engineering,* Roger Adams, president of the American Chemical Society, L H Marks, president of the Chemists' Club, W T Read, Rutgers University, H J Schnell, general manager, *Oil, Paint and Drug Reporter,* T B Wagner, consulting chemist, R Gordon Walker, vice president, Oliver United Filters, Inc , M C Whitaker, consulting chemist, and Fred W Payne and Charles F Roth, co managers of the exposition

AN EXHIBIT OF RARE PREHISTORY MATERIALS

THE Department of Anthropology, University of Minnesota, is fortunate in possessing an unusual number of unique prehistoric human skeletal and artifact materials which are now being placed on exhibition for the first time They will be available in Wesbrook Hall, Main Campus, for the meeting of the American Association for the Advancement of Science, which will be held from June 24 to 29

Among the most important specimens are the following

"Minnesota Man," type skeleton of oldest known accredited man in Western Hemisphere, and two artifacts found therewith,

"Mechte-el Arbi," type-skull of North African Capsian or Getulian culture, of some 30,000 years ago Besides, there is the extensive Debruge archeological collection from North Africa,

Twelve additional Mechte el Arbi skulls—four of which were dug by the University of Minnesota, together with 6,000 flints of African shell heap culture, some 30,000 years old, also dug by the University of Minnesota,

One half of the type-specimen flint artifacts of Capsian or Getulian African culture,

The type specimens of Mousterian stemmed "points" from Africa,

The first Mousterian coup-de-poing from the type site at Le Moustier, France,

The type artifacts of the ivory culture of mid North America,

Two atlatl stone weights found in Minnesota,

Typical Yuma flints found in Minnesota,

Typical Folsom flints found in Minnesota,

Four, perhaps unique copper fishing gorges from a Minnesota habitation site

Minnesota "Browns Valley Man," type-skeleton and six Yuma Folsom flints found with said type skeleton,

Extremely rare, if not unique, evidences of abundant cannibalism among one group of mound burying Minnesota Indians,

Extremely rare Minnesota pottery from both habitation sites and mound burials

ALBERT ERNEST JENKS

THE LIBERTY HYDE BAILEY HORTORIUM

ONE of the largest private herbariums in the country, including comprehensive records of the cultivated plants of the world, has become the property of Cornell University as a gift of Dr Liberty Hyde Bailey, professor emeritus of agriculture, and Mrs Bailey The collection, which will be designated as the Liberty Hyde Bailey Hortorium, comprises upwards of 125,000 mounted herbarium sheets and other similar material, especially rich in the cultivated floras of the world and comprising types of new species in the palms, Carex, Vitis, Rubus and other groups, there are included 4,000 technical and professional books and thousands of photographs and card indices with working equipment The buildings which house these collections and about a quarter of an acre of surrounding land are included in the gift For the past fifteen years illus-

trated publications have been issued from the establishment under the general title Gentes Herbarum

In offering the collection to the university, Dr Bailey wrote

> The value of these collections depends on the use that is made of them The accumulations have been assembled over many years with the hope that they may constitute the basis of a departure in education and research a new unit unlike any now in existence and which need not duplicate the field of any other department Its primary purpose is to record and study the cultivated flora of the world to the end that the species may be accurately identified as a scientific basis in horticulture plant breeding, pathology and any other departments of knowledge that work with domesticated plants and to provide archives of the plants that men at any time or place may grow

The university has authorized the establishment of an administrative unit in the College of Agriculture to be known as the Liberty Hyde Bailey Hortorium, to be placed under the direct supervision of a staff member A full time curator, whose duty shall be the general care and supervision of the hortorium, will also be appointed There will be an advisory board consisting of representatives of the major fields of plant science and two members at large appointed by the president, together with the supervisor of the hortorium and the curator One or more graduate fellowships, to be known as the Liberty Hyde Bailey Botanical Fellowships, will be established

RECENT DEATHS

DR CHARLES E ST JOHN, research associate at the Mount Wilson Observatory of the Carnegie Institution of Washington, died on April 26 He was seventy eight years old

DR ERNST BISCHOFF, head of the chemical and pharmaceutical firm of the Ernst Bischoff Company Inc, New York, died on April 19, at the age of seventy one years

THE death is announced of Dr J Loring Arnold, professor emeritus of electrical engineering at New York University He was sixty seven years old

RICHARD MORRIS HOLMAN associate professor of botany at the University of California, died suddenly on April 23, aged forty nine years

THE death is announced of Sir Richard Rawdon Stawell, of Melbourne, Australia, president-elect of the British Medical Association

HERBERT BRERETON BAKER, professor emeritus of chemistry at the Imperial College of Science, London, died on April 29, aged seventy three years

SCIENTIFIC NOTES AND NEWS

DR HERBERT SPENCER JENNINGS, professor of zoology at the Johns Hopkins University, has been elected Eastman professor at the University of Oxford for the academic year 1935–36 Dr Arthur H Compton, professor of physics at the University of Chicago, is this year Eastman professor The professorship was founded by the late George Eastman to send American scholars to Oxford, and the endowment is in the hands of the Association of American Rhodes Scholars

ON the occasion of the annual dinner of the National Institute of Social Science the gold medal of the institute was awarded to Dr Harvey Cushing, since 1933 Sterling professor of neurology at Yale University

AT the annual convocation of the American College of Physicians, which met in New York City during the week of May 1, presentation of the John Phillips Memorial Medal was made to Dr Leo Loeb, professor of pathology at Washington University, St Louis Professor Loeb delivered the convocation oration, speaking on "The Thyroid-stimulating Hormone of the Anterior Pituitary Gland" Dr O T Avery of the Rockefeller Foundation, to whom the John Phillips award was made for 1932 33, and Dr William B Castle, of the Harvard Medical School, to whom the award was made for 1933–34, received the medals at the ceremony

AT the New Orleans meeting of the Electrochemical Society, the Acheson Medal and $1,000 Prize for 1935 was awarded to Frank J Tone, president of the Carborundum Company at Niagara Falls, for his distinguished work in electrothermics The presentation will take place on October 10, at Washington, D C, where the fall convention of the society will be held

DR. WALTER B CANNON George Higginson professor of physiology at the Harvard Medical School, was elected an honorary member of the National Academy of Medicine of Spain at the recent celebration of the two hundredth anniversary of its founding

PROFESSOR GUÉRIN, director of the anti tuberculosis vaccination service of the Pasteur Institute of Paris, has been elected a fellow of the French Academy of Medicine

W B HERMS, professor of parasitology at the College of Agriculture of the University of California, has been decorated by the French government with the rank of Chevalier du Mérite Agricole

AT the annual meeting of the Boston Society of Natural History, held on May 1, the following officers were elected for 1935–1936 *President*, F W Hunnewell, *Vice presidents*, Nathaniel T Kidder, Glover M Allen, William M Wheeler, *Secretary*, Clinton V MacCoy, *Treasurer*, Augustus P Loring, Jr, *Trustees*, Charles H Blake, Ralph Hornblower, John C Phillips, Alfred C Redfield, Charles H Taylor, William H Weston, Jr At the same meeting the annual Walker Prizes in Natural History, offered this year for the best memoir on any subject in the field of general zoology, were awarded to Caryl P Haskins, Harvard University, for his paper on "The Perception of Sound and Sound Production in Certain Ants" (first prize) and Dr T T Chen Yale University, for his paper on "Chromosome Studies in Protozoa I Observations on Mitosis in Some Opalinids (Ciliata), with Special Reference to the Behavior and Individuality of Chromosomes" (second prize)

AT the meeting of the Louisiana Academy of Sciences held in Alexandria on March 29 and 30, O L Meehan, of the U S Bureau of Fisheries, Natchitoches was awarded the gold medal of the academy for his paper on "The Relative Importance of the Plankton Constituents of the Bass Ponds as Measured by their Organic Contents" The twenty five dollar prize awarded by the Graduate School of Louisiana State University was given to George H Lowery, Jr, graduate student in the department of zoology of the university The subject of his paper was "Preliminary Notes on the Biological Survey of Louisiana—Life Regions and Mammals"

THE Howard Taylor Ricketts Prize of the University of Chicago for 1935 has been awarded to Floyd S Markham, advanced student in bacteriology, for his paper entitled "Studies in the Submaxillary Gland Virus of the Guinea Pig" and to Sion W Holley, assistant in pathology, for his paper entitled "Corneal Reactions of Normal and of Tuberculous Guinea Pigs to Tuberculo-protein and Tuberculo-phosphatide" Established in honor of Dr Howard Taylor Ricketts, who discovered the germ of typhus fever and died from the disease while working in Mexico in 1910, the award is announced each year on May 3, the anniversary of his death The prize is given to a student or students for the best results in research in either the department of pathology or the department of hygiene and bacteriology

JAMES H CRITCHETT, vice president of the Union Carbide and Carbon Research Laboratories, Inc, New York City, has been elected to succeed Dr Hiram S Lukens, of the University of Pennsylvania, as president of The Electrochemical Society, Inc

DR. ERNEST B BRADLEY, of Lexington, Ky, was chosen president-elect of the American College of Physicians at the recent Philadelphia meeting He will take office at the session a year from now Dr James Alex Miller, professor of clinical medicine at the College of Physicians and Surgeons of Columbia University, was inducted as president. He succeeds Dr Jonathan C Meakins, professor and head of the department of medicine at McGill University, who gave the presidential address, in which he traced the history of the various colleges of physicians and surgeons Dr Arthur R Elliott, of Chicago, Dr David P Barr, of St Louis, and Dr Egerton L Crispin, of Los Angeles, were elected first, second and third vice presidents, respectively

AT a recent meeting of the Seismological Society of America, Professor S D Townley was elected president of the society At the same time he relinquished the editorship of the *Bulletin* of the Seismological Society, which he has held since 1911

PROFESSOR F ELLIS JOHNSON, head of the department of electrical engineering at the Iowa State College, has been appointed dean of the School of Engineering at the University of Missouri

PROFESSOR THORNDIKE SAVILLE, since 1932 head of the department of hydraulic and sanitary engineering at New York University, has become associate dean of the College of Engineering

DR. ANDREW HUNTER, Gardiner professor of physiological chemistry at the University of Glasgow, has been appointed professor of pathologic chemistry at the University of Toronto He succeeds the late Professor Victor J Harding

THE retirement, after serving continuously for forty years, is announced of Professor Ransom A Moore, head of the department of agronomy at the University of Wisconsin He will be succeeded by Olaf S Aamodt, head of the department of field crops of the University of Alberta

DR. CARL E GUTHE, director of the Museum of Anthropology at the University of Michigan, has been made chairman of the Division of Social Sciences, established by the regents in May, 1934, at the request of the Social Science Research Council of the university It will consist for the present of the following departments and schools anthropology, business administration, economics, geography, history, law, philosophy, political science, psychology and sociology

DR. HOWARD S BRODE, professor of biology and curator of the museum at Whitman College, Walla Walla, Wash, for the past thirty-six years, will retire as head of the department at the close of the present

academic year He will continue to serve as curator of the museum Dr Malcolm D Brode has been appointed acting head of the department for the coming year

DR. ROBERT T HATT has resigned as assistant curator in the Department of Mammalogy of the American Museum of Natural History as of July 1, to become director of the Cranbrook Institute of Science

THE appointment of members of an advisory council for the George S Cox Medical Research Institute for the study of diabetes, which is one of a group of related medical units affiliated with the University of Pennsylvania, has been announced by Dr Alfred Stengel, vice president of the university in charge of medical affairs Those appointed are Dr J B Collip, professor of biochemistry at McGill University, Dr George A Harrop, associate professor of medicine, the Johns Hopkins University, Dr Elliott P Joslin clinical professor of medicine, Harvard University, Dr Phillip E Smith, associate professor of anatomy, School of Medicine, Columbia University, Dr Rollin T Woodyatt, professor of medicine, University of Chicago, Dr O H P Pepper, professor of medicine, University of Pennsylvania

DR. IRVING LANGMUIR, director of the Research Laboratory of the General Electric Company, gave a lecture at Harvard University on "Films Consisting of One or More Layers of Molecules" on May 7 under the auspices of the Harvard Chapter of the Society of Sigma Xi

THE annual Phi Beta Kappa address at Colgate University was delivered on April 16 by Professor Douglas Johnson, of Columbia University, who took as his subject "Muddy Thinking"

THE second annual Harry Hayward Charlton Memorial Lecture in Anatomy was delivered on April 30 by Dr H. B Latimer, professor of anatomy at the University of Kansas, at the Medical School of the University of Missouri Professor Latimer spoke on "Growth as Illustrated by Laboratory Animals"

DR. F H PIKE, of Columbia University, lectured before the Washington Square College Chapter of the Psi Chi (national honorary society in psychology) on April 17 on "The Nature of Nervous Reactions"

THE annual dinner of the Cornell Medical College was held at the Biltmore, New York City, on May 2 The speakers included President Livingston Farrand, of Cornell University, and Dr James Ewing, professor of oncology at the college

FOR several years the department of geology and geography of Northwestern University has had an exchange lecture plan There have been two exchanges with the University of Cincinnati, one with Washington University, St Louis, and this year with George Peabody College, Nashville In this year's exchange, Professor W H Haas gave a series of four lectures on "The Geography of the Tropics" on April 11 and 12, and Professor A E Parkins filled the return engagement at Evanston on April 25 and 26, speaking on "The Geography of the South"

THE Wilbur Wright Memorial Lecture and conversazione of the Royal Aeronautical Society will take place in the Science Museum, London, by permission of Colonel E E B Mackintosh, director of the museum, on May 30 The lecture will be read by D W Douglas, president of the American Institute of Aeronautical Sciences, and designer of Douglas aircraft

THE sixth annual meeting of the American Association of Physical Anthropologists was held at the Wistar Institute of Anatomy, Philadelphia, on April 25, 26 and 27 The annual public address was delivered by Professor T Wingate Todd, of Western Reserve University, who spoke on The Bodily Expression of Human Growth and Welfare" At the annual dinner the guest speaker was Professor C U Ariens Kappers, of the University of Amsterdam

THE ninety fourth Congress of German scientific men and physicians, which had been arranged for this year, has been postponed to May 24, 1936, when it will be held in Dresden under the presidency of Professor Sauerbruch

THE dedication of the new library and chemical buildings at the University of Arkansas will be held on June 10 At the exercises for the chemistry building Dean V L. Jones will preside, and the main address will be given by Dr Edward Bartow, president elect of the American Chemical Society

THE Regents of the University of Michigan have changed the name of the department of chemical engineering to the department of chemical and metallurgical engineering and have authorized the dean and faculty of the College of Engineering to arrange a program in metallurgical engineering leading to the degree of Bachelor of Science in Engineering (Metallurgical Engineering)

THE School of Medicine of George Washington University announces the acceptance of several grants for various research projects as follows From the Rockefeller Foundation the sum of $25,500 in support of studies in the department of biochemistry, a renewal of the Kane-Kotz Fund of $1,700 for studies on clinical endocrinology in the department of obstetrics and gynecology, from the Eli Lilly Company the sum of $1,200 for a fellowship in biochemistry, and a grant

of $1,800 for the study of the post pituitary hormones from Parke, Davis and Company

Two gifts, amounting to $243,000, have been made to the University of Chicago by the Rockefeller Foundation The larger gift, of $168,000, is to assist in establishing a department of psychiatry and the second gift, of $75,000, is for support of research in the humanities With the establishment of the department of psychiatry as a division of medicine, there are represented in the south side medical school all the ordinary branches of medical research The new psychiatric division will maintain twelve beds in a special unit of the University Clinics, and emphasis will be laid on research in the causes and cure of mental disease Appointment of a psychiatrist as head of the department will be made before July 1, when the new unit will be established

A GIFT of £10,000 has been received from J Albert Thompson for the purpose of establishing a commercial laboratory in the University of Edinburgh This will provide for the immediate requirements in staff and equipment for a laboratory providing the approved methods of training for students for the commerce degree

A JOINT expedition representing the museum of the University of Pennsylvania and Columbia University has left for Venezuela where, under the leadership of Dr M Vincent Petrullo, four months will be spent in investigating the Goajiros, one of the least known primitive tribes Accompanying Dr Petrullo will be Mrs Gwyneth Browne Harrington, of Boston, Miss Lydia du Pont, of Wilmington, Del, and Lewis Korn, of Philadelphia, assistants in the South American Section of the University Museum, and Dr and Mrs Paul Kirchoff, who will represent Columbia University The group will stop over for a few days at Curaçao and then proceed to Maracaibo, Venezuela, before journeying into the interior In addition to the University Museum and Columbia University, the expedition is being sponsored also by the Latin American Institute, Philadelphia, which has recently been formed in response to a demand for an agency to organize and coordinate research and to disseminate information on the entire field of Middle and South American ethnology, archeology, anthropology and linguistics The forthcoming investigation of the Goajiros is the first opportunity of the institute to carry out actively the purposes of its foundation

THE British Mount Everest Committee has arranged to send to Mount Everest this summer a small reconnaissance expedition in preparation for a further attempt on the summit in the early summer of 1936, under the leadership of Hugh Ruttledge The reconnaissance will be led by E E Shipton, and will include H W Tilman, Dr Charles Warren, E H L Wigram, L. V Bryant (from New Zealand), Michael Spender and one or more members from India of the Himalayan Club not yet finally selected

DR. SVEN HEDIN, accompanied by members of his expedition, arrived in Stockholm on April 15 The London *Times* reports that he was received at the station by a large and cheering crowd, headed by the Duke of Dalecarlia, grandson of the King Later in the day a deputation from the Swedish Royal Geographical Society waited on him at his home and presented to him a superbly bound publication and the Austrian Minister handed to him a high Austrian distinction

DISCUSSION

THE ORIGIN OF THE HIGHER FLOWERING PLANTS

WHEN recently reading Dr A C Seward's "Plant Life through the Ages" (1933) the old puzzle concerning the apparently sudden dominance of Angiosperms in Cretaceous time came before me and led to the development of some ideas which may be worth discussing It has been commonly assumed by botanists than the first Angiosperms were trees or at all events woody plants This opinion appears to be strongly fortified by the fossil record, the remains found belonging almost exclusively to arborescent forms But evidence of this sort is probably not conclusive, for such reasons as the following

(1) In the existing flora, herbaceous plants are especially prevalent in mesophytic and arid situations, and from their mode of growth, as well as the circumstances of their environment, are extremely unlikely to be preserved as recognizable fossils The deciduous leaves of trees, which often cover the ground after a storm, are very much more likely to be covered up and preserved

(2) No one can possibly doubt that herbaceous plants abounded during mid-Tertiary time, much as they do to-day Yet if we examine Knowlton's "Catalogue of the Mesozoic and Cenozoic Plants of North America" (1919) the extreme poverty of herbaceous genera in the recorded extinct floras is astonishing

Thus the family Ranunculaceae is represented only by a supposed *Thalictrum*, so doubtful that it was not given a specific name Since then I have found buttercup seeds in the Florissant shales (Miocene), but of the many species of Ranunculaceae which must have been the ancestors of the present flora, there is hardly a trace The same may be said of numerous other families

(3) The evolution of the modern flower must have been closely connected with the development of the flower-visiting insects, especially the bees and their relatives Now the earliest known bees are from the Oligocene (Baltic amber) and the oldest sphecoid wasp is from the Green River Eocene These Hymenoptera are by no means primitive types, but are essentially similar to those now living They certainly had Mesozoic ancestors which have not been found

(4) To this day, bees abound especially in dry regions, such as Arizona, Turkestan, Algeria or the karroo of South Africa There may be found a prodigious number of species, together with a rich flora to which the bees are adapted These can, however, be a rather varied flora without a variety of bees, as shown by the Pribilof Islands, which have only one kind of bee (*Bombus kincaidi*)

Thus it appears probable that the developing angiosperms, together with their developing insect visitors, occupied mainly upland and relatively dry regions, and if so, would rarely chance to appear as fossils The soft, non deciduous leaves would rarely be scattered on lake shores, and still more rarely would the remains, if preserved, be recognizable The bees, if present, would be more likely to be recognizable, but they have not been found on the Mesozoic, although they must have existed

If we assume that the early angiosperms were not woody, but herbaceous, and were at the same time largely confined to uplands or dry regions, it is easy to understand why they do not appear in the fossil record, or rather, are represented by few and more or less doubtful fragments

I wrote briefly to Dr Seward on this subject and he at once referred me to the most illuminating discussion in Chapter V of Mrs Arber's work "The Gramineae" (1934) Here the problem of herbaceous vs arborescent origins is discussed in the broadest and most lucid way, and it is shown that the assumption that woody types came first is by no means necessarily valid. Zoological evidence is added to the botanical, and the chapter is so full of original ideas that a brief summary is impossible

Supposing it to be true that a rich herbaceous flora of angiosperms existed during the earlier part of the Mesozoic, how can its existence be demonstrated? Just as rich early fish faunas have been revealed by the study of scales and otoliths, so it may well be that floras will be proved to have existed by the discovery of small seeds and pollen, and very likely also of calyces or sepals No adequate search has been made for such objects in the rocks which might contain them R P Wodehouse (1933) has described and illustrated the pollen of the oil shales of the Green River Eocene, and has shown that many species, belonging to thirty four genera, could be recognized He states, however, that herbaceous plants, apart from a few aquatics, are not represented This statement must be qualified by another, that only about a third of the pollen species present has been described and identified Wodehouse says, "The absence of terrestrial herbs is entirely in keeping with the theory put forward by E W Sinnott, that the herbaceous type was developed in temperate regions during Eocene time in response to a progressive refrigeration At this period terrestrial types were only beginning to be developed" Any one who has considered the slowness of plant evolution, and the small amount of change in the insect fauna since early Tertiary times, can not readily believe that the great and varied herbaceaus flora of to-day had such a recent origin A really full and adequate discussion of the problem might well require a book, but I venture to suggest that enough has been adduced to justify a minute examination of Jurassic, Triassic and even Permian lake bed deposits, wherever they are suitably fine grained, in the hope of finding small seeds or other remains, and perhaps especially pollen, representing an herbaceous flora of angiosperms

T D A COCKERELL

UNIVERSITY OF COLORADO

THE MOTION OF GLACIERS

AFTER reading Dr Chamberlin's objection (SCIENCE, December 7, 1934) to my contribution (SCIENCE, November 2, 1934) on "The Motion of Glaciers" he and I had an oral discussion of the topic This reply (which will have been seen by Dr Chamberlin before it is sent to the editor) will endeavor to make clear our differences From it the reader should without further notices be able to come to his own conclusions in regard to the merit of the several contentions It is of course to be realized that there is not space in SCIENCE for a complete review of the problem The monograph by Hess which prompted the first notice covers that ground fully if not comprehensively

From our discussion it developed that Dr Chamberlin was of the impression that my piece was in some sense unfair This because I used as tenets of the shear theorists formulations which originated with

him or with T C Chamberlin and which he thought should not be so applied I wish absolutely to disclaim any intention of putting any one in a false light Further although, in discussion, Dr Chamberlin said it is his own conviction that inter grain shift is the chief process of glacier motion there remains a difference of interpretation of the phenomenon that is not cleared up by the apparent agreement in views this adherence suggests The difficulty is that Dr Chamberlin, as I understand him, and the shear motion adherents, insists that glaciers be regarded as essentially rigid masses, whereas the other view point is that the flow function of glaciers derives wholly from a condition of viscosity or plasticity of the glacier ice The results speak definitely for the solidity and elastic rigidity of moving glacier ice, and decisively against liquid or viscous flow as the main type of adjustment under stress"[1] It is difficult to see how such a statement can be regarded as any less 'sweeping" than the one I made and to which Dr Chamberlin objected

The following paragraphs apply in rebuttal to Dr Chamberlin's point by point protest

(1) "What else besides sliding could cause striation, etc ?' Why, a stiff viscous body holding graving tools large and small Glass is a viscous substance equally with fluid lava to which latter anti viscous glacial flow adherents immediately turn for an analogy Further, even if a glacier is regarded as a rigid crystalline body the fact of pressure-temperature melting equilibrium at its bottom would tend to bring about imbedding in the ice of any rock graving tool because the projection of such a tool would induce differential pressure with relief by melting and refreezing Theoretically, one ought to expect no damage to a polished metal surface from application to it of coarse carborundum flakes on the under side of a cake of beeswax

(2) Intermittent slip The fact of such slip in the upper cover, marginal and terminal zones of a glacier where the thickness of the ice is insufficient to develop true glacial, that is, viscous flow, is well known and was specifically referred to in the third paragraph of my original notice But such motion is merely an induced result of the true glacial flow

(3) Solid shearing of aggregates of granules Like intermittent slip applies only to marginal and cover ice

(4) Idiomolecular exchange Although Dr Chamberlin here maintains that he has all along upheld the concept that "movement between the granules to be the fundamental mechanism" of glacier motion, such contention does not seem to be in keeping with the declaration made in his author's abstract quoted above If he visualizes the idiomolecular exchange as a vast succession of dot and dash yieldings between dry crystals the process could perhaps be regarded as non viscous yield But it should be realized that the idiomolecular exchange serves primarily (perhaps exclusively) the growth of larger crystals at the expense of smaller ones Such idiomolecular growth was fully demonstrated to occur under conditions of minimum static pressure and essential freedom from differential stresses by Emden[2] Further, it is well known to chemists that large crystals immersed in solutions of their constituent material will rapidly consume any small crystals present, but that such idiomolecular transfer proceeds very slowly, if at all, under dry contact Hence it is again the salt solution, the chief tenet of my concept, that functions ideally to promote the growth of the glacier crystals However, to return to the main argument, such idiomolecular exchange is not a *modus operandi* of glacier motion Whether made up of a few large crystals or a vast number of smaller crystals the volume of ice must remain the same As 'explained in various text books' (one copying from another?) it is faintly implied that the growth of crystals and the melting and refreezing under changing conditions of pressure permits a settling down of the glacier by the closing up (with escape of air) of previously existing "pore' space Such process may be transiently operative in the upper reaches and upper levels of a glacier but can not be invoked for the main action of glacier motion On the other hand, without such free space there can be no motion by these means Where could the melt water go?

Instead, as previously maintained, glaciers wallow down their courses, the crystals growing and shifting in relation to each other through the medium of the liquid salt solution which surrounds them The total volume of such solution varies with pressure and temperature, its thickness between crystals becoming greater as the size of the crystals increases because of the diminishing surface area Thus it is constantly being made adequate to its task as a lubricant

Dr Chamberlin further protests that I ought not lump the propositions (1) to (4) under the heading shear concept But as I see it they are all used to bolster up the idea of glaciers as rigid elastic bodies and to provide the conditions which will result in shear as a basic means of glacier motion Hence the grouping is appropriate

It is not fitting to ask space in SCIENCE to build up the case for appreciable salt supplies in the precipitation that nourishes glaciers Further, *ad interim*,

[1] R T Chamberlin, Abstract in *Geologisches Zentralblatt*, Vol 37, 1928, No 1337, p 412

[2] Robert Emden, *Denkschriften d Schweiz Naturf Ges*, 33, Zurich, 1892

J. V. Harrison has himself found an explanation for the salt glaciers.[8]

O. D. von Engeln

Cornell University

A SYSTEM FOR SUBJECT REFERENCE FILES FOR SCIENTIFIC LITERATURE

In the course of a recent investigation, which has necessitated reading a portion of the extensive literature relating to anaerobic bacteria, the authors have devised a simple system for the routine cross indexing of topics covered in the scientific articles reviewed. It is believed that the system proposed may be applied with benefit for any field of science, either in listing current publications or as a basis upon which may be built a permanent bibliography for a particular field. The system is intended for personal use, and it will probably be found to work best if applied to a limited field, in which its user is himself working.

In setting up the system it is first necessary to outline carefully the field which is to be covered by the bibliography. A portion of the system which we have found useful in our field may be given in detail to more fully explain the key. For illustration, three general divisions of our present file will serve:

A Source of isolation
- a Soil
- b Dairy products
- c Food products other than b
- d Intestinal tract or feces
- e Body other than d
- f Water
- g Miscellaneous

E Products of metabolism (other than toxin, etc.)
- a Acids
  - 1 Acetic
  - 2 Butyric
  - 3 Lactic
  - 4 Propionic
  - 5 Others
- b Alcohols
  - 1 Butyl
  - 2 Ethyl
  - 3 Isopropyl
  - 4 Others
- c Acetone
- d Intermediates of fermentation
- f Gases (CO_2, H_2, H_2S, etc.)
- g Miscellaneous

G Serological reactions
- a Agglutination
- b Precipitation
- c Complement fixation
- d Toxin antitoxin
- e Miscellaneous

The outline key, part of which is shown in Fig. 1, is printed in skeleton of letters and numerals on the lower half of unlined 4″ by 6″ index cards (we have found it useful to provide for expansion of the outline by extra divisions of each section). The right half of the card is lined for notes.

At the time the original article is reviewed a master card is made, giving complete citation of the author or authors, title of the article and reference. Check marks are then made on letters or numerals, which

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Welch, W. H.
Morbid conditions caused by *Bacillus aerogenes capsulatus*
Johns Hopkins Hosp. Bul. *11*: 185–204, 1900.
A abcdefgh G abcdefgh ————
E abcdefgh ————
1234567 ————
1234567 ————

Fig. 1. Showing a convenient arrangement of reference and part of the key.

indicate the topics considered. For each section so indicated on the master card a separate card is to be typed with author and title citation; these cards are marked to indicate only the section in which they are to be filed. Notes or short direct statements of results may be added to the appropriate subject card, if desired. Two files are then maintained, an author file of the master cards and a subject file of the cross index cards.

An advantage of the system is that it eliminates the need for routine briefing of articles. For the average paper, a quick reading or only checking of subject matter is all that is necessary; it is thus possible to cover several papers or even volumes in one evening. It will be found also that the key is unconsciously memorized and that there is little trouble in checking off topics rapidly and accurately, particularly if the field is limited and is of major interest to the bibliographer himself. The system is a time saving device, for once the master card is prepared and the correct number of subject cards indicated, ordinary stenographic help can be used to copy the reference to the cross cards. If extended to cover in a systematic fashion all the back volumes of journals containing pertinent papers, it becomes a permanent file from which at least two types of questions may be answered in a minimum of time. These are (1) what topics are covered by a particular paper (the author of which is known), and (2) what articles deal with any one specialized topic? This latter use is possible only through the multiple filing, and that is possible through elimination of abstracting, always tedious and inadequate.

L. S. McClung
Elizabeth McCoy

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ELECTRODES COME IN PAIRS

For some years there has been evident on the part of physiologists a tendency to call a pair of electrodes an electrode. Perhaps the tide of this gross misuse of physical language has gained so much momentum that nothing can stop it, but every effort should be made to do so if possible.

[8] J. V. Harrison and N. L. Falcon, *Geological Magazine*, 71: 537, December, 1934.

The reasons for this misuse of terms are probably that many who use electrodes for physiological or medical purposes are so untrained in physics and chemistry that they do not know the true meaning of the word, and that frequent use of a device which facilitates the application of a pair of electrodes to a nerve or other tissue, as a single unit, leads them to form the habit of thinking of it in the singular

These reasons do not justify the practice The word "electrode" has a definite physical meaning and should be used with respect to that meaning This use of the singular where the plural is meant is analogous to calling a pair of boots a boot, or a pair of gloves a glove The difference between a pair of eye glasses and a monocle should serve to stress the point

The misuse of the singular can not be excused on the ground that in practice one always uses a pair of electrodes, for there are cases in which an electrode may be applied singly, and the singular is needed to designate such a case Often a diffuse electrode (usually grounded) is applied to one part of the preparation, while a small localizing electrode is applied to the particular structure being studied This applies both to stimulation and to leading off of electric responses If the word "electrode" is habitually used to denote a pair of electrodes, no suitable term is left for the single electrode In short, the use of a word with a definite physical meaning in an improper sense opens the way to endless confusion, and should be heartily condemned

ALEXANDER FORBES
HARVARD MEDICAL SCHOOL

THE NATIONAL ACADEMY OF SCIENCES.[1] II

Transformations of differential elements EDWARD KASNER The simplest type of differential element is a lineal element (x, y, y') defined as a point with an associated direction General element transformations, studied by the author, carry a curve, not into a curve, but into a *series* of ∞^1 elements, not in united position A simple example of a series is a *turbine*, obtained from the elements of a circle by applying a turn T (through a fixed angle) or a slide S (through a fixed distance) All turns and slides generate a 3 parameter group G_3 This is a subgroup of the general group G_{15} which converts turbines into turbines We next study general isogonal series and equitangential series obtained by applying T and S to general curves The largest group converting isogonal series into such is shown to be the product of the conformal group and the turn group The dual theorem gives the product of the equilong group and slide group Transformation theories are obtained for velocity and natural families in dynamics and also for the dual types The general transformation of normal congruences has application to optics Finally, the osculating turbines of general series are studied, giving a wide generalization of the classic theory of evolutes which had its origin in Huyghens's wave theory

Analysis of 18,000 proper motions derived at the Leander McCormick Observatory P VAN DE KAMP and A N VYSSOTSKY (introduced by S A Mitchell) Proper motions of 18,000 stars between magnitudes 7½ and 14 have been derived photographically in 341 regions These regions, forming a sample of about one half of one per cent of the total area of the sky, are representatively distributed north of Declination $-30°$ The motions have been made absolute by means of the motions of 574 bright stars kindly furnished by the Dudley Observatory in advance of publication. In addition, spectra for 5,200 of these faint stars were secured at the Harvard College Observatory The more important results are (1) Corrections to Newcomb's precession constants were found with high precision, due to the large number of faint stars with small motions which constitute an almost ideal "fixed" reference system (2) The direction to the center of the rotation of the galaxy and the constants of the differential galactic rotation were found practically identical with corresponding figures previously derived by various investigators from the motions of the bright stars Thus, it is shown that the phenomenon of galactic rotation is not limited to restricted groups of high luminosity stars, but is shared by the general population of the galaxy The galactic longitude of the center was found to be 321°, in the constellation of Scorpius (3) The position of the Solar Apex, at right ascension, 19 0 hours and declination, +36°, was found to differ by 15° from the Apex derived with respect to the bright stars This is thought to indicate a higher percentage of high velocity stars among the apparently faint stars The results given under (1) (2) and (3) were obtained from one simultaneous solution for the 8 unknowns involved, they are therefore independent of any outside data, except the system of the new "Boss" catalogue (4) In general, the secular parallaxes are somewhat larger in northern galactic latitudes than in the corresponding southern latitudes, the smallest parallaxes being found not in the Milky Way as might be expected but about 15° away from it, north and south Furthermore, the parallaxes of the groups of fainter stars in the Milky Way are much larger than had previously been supposed These all indicate heavy obscuration near the plane of the Milky Way The results given under (3) and (4) were confirmed in a general way from a discussion of the proper motions in right ascension of some 9,000 faint stars used in parallax determinations at the Allegheny, Johannesburg and McCormick Observatories (5) A study of the ellipsoidal distribution of motions revealed a clear dependence of the position of the Vertex on absolute magnitude. Thus the stars of large proper motion (predominantly

[1] Continued from page 426

dwarfs) have their Vertex at galactic longitude 330°, *i.e.*, close to the galactic center. Again, the Vertex found from stars in low galactic latitudes is at 347°, whereas from stars in high galactic latitudes where the proportion of dwarfs is larger, the vertex is found to be at 337°. This same dependence appears clearly in the works of Wilson and Raymond, of Jones and of Hufnagel, although none of them attached great weight to it. Furthermore, a re-analysis of the Radcliffe proper motions of faint stars shows the same effect. Thus, the dwarf stars conform to the simple theory of galactic rotation and only the behavior of the giants, which constitute a relatively unimportant part of the mass of the galaxy, remains to be explained.

Recent advances in our knowledge of the solar chromosphere: DONALD H. MENZEL (introduced by Harlow Shapley). Spectra of the chromosphere, secured by Lick Observatory at the eclipses of 1930 and 1932, have yielded a wealth of new data concerning physical conditions in the solar atmosphere. The spectrograms were calibrated photometrically, and relative intensities of emission lines at various levels have been obtained. Dr. Joseph H. Moore, of Lick Observatory, and I have measured the 1930 moving-plate spectra, and have evaluated the intensity gradients of numerous important lines. Dr. G. G. Cillie, Mr. H. H. Lane and I have investigated the 1932 spectrograms. The following conclusions are based on the best available data from all eclipses, including those of 1905 and 1908. The intensity gradient is logarithmic, *i.e.*, the intensities I at height x cms above the base may be represented in terms of the intensity I_o at the base by the following formula: $I = I_o e^{-ax}$, where a is the decrement constant. a appears to have practically the same value for all lines of a given atom in a particular stage of excitation, irrespective of the magnitude of I_o, which indicates that self-absorption is negligible. Lines of high excitation potential have higher values of a than lines of low excitation potential. For a given element, a is greater for the neutral than for the ionized atom, a result to be expected from ionization theory. a shows a tendency to increase with atomic weight, as if the heavier atoms were "settling out." Of particular significance are the ultimate lines of Ca^+, Sr^+ and Ba^+, for which the respective a values are, within experimental error, directly proportional to the molecular weights. Marked variations in a are shown to exist from eclipse to eclipse and at different points around the sun at a given time. These changes are especially pronounced for the lines of He and He^+. The observed a's for H are from three to five times less than would be expected in an atmosphere of pure H in gravitational equilibrium at 6,000°. The whole character of the chromospheric spectrum bears out an earlier conclusion, *viz.*, that the chromosphere is a hot-spot phenomenon. It appears to be impossible to account for the nature of the spectrum without postulating either (1) the existence of ultra-violet radiation (λλ 1,000 – 100) in excess of that to be expected from a black-body at temperature 6,000°, or (2) the presence of high-velocity electrons ejected from the sun.

The shape of the corona and its relation to the sun-spot cycle: S. A. MITCHELL. Measurements of the coronas of 1932 and 1934 have given the surprising result that the 1932 corona 1½ years before minimum of sun-spots is more elongated than the corona of 1934, which took place almost exactly at the time of spot minimum. A total of 18 coronas beginning in 1893 have been measured and their ellipticities determined on a uniform plan. A close correlation is found to exist between the shape of the corona and sun-spot data. For many years the coronas with long equatorial extensions and pronounced polar rays have been called the "sun-spot minimum type," while the circular corona has been called the "maximum type." All the graphs, no matter what spot or prominence numbers are plotted, without exception tell the same story, namely, that the most pronounced minimum type of corona does not take place exactly at sun-spot minimum nor does the maximum type of corona occur at the time of maximum of spots. As long as 2½ years before spot minimum the corona is quite as elongated as it is at the time of minimum of spots. The most elongated corona is found 1½ years before minimum of spots and likewise the corona closest in shape to a circle takes place 1½ years before spot maximum. The corona of 1934 had lost its pronounced "minimum type" characteristics.

Some rare amphibians and reptiles of the United States: A. H. WRIGHT (introduced by L. Stejneger). Our project for the last ten years has been to photograph and to describe live representatives of every form of amphibian and reptile of the United States. Some 10,000 photos have accumulated. In our search, notes on living representatives of rare, recently described or little known forms have amassed, and we present herewith remarks on the following twenty forms: *Amphibians: Ambystoma cingulatum* Cope; *Ambystoma mabeei* Bishop; *Gyrinophilus porphyriticus duryi* (Weller); *Aneides aeneus* (Cope); *Leptodactylus albilabris* (Günther); *Rana heckscheri* Wright.

Reptiles: Crotaphytus reticulatus Baird; *Sceloporus disparilis* Stejneger; *Sceloporus torquatus cyanogenys* Cope; *Neoseps reynoldsii* Stejneger; *Coluber stejnegerianus* (*conirostris*) (Cope); *Elaphe rosacea* (Cope); *Elaphe subocularis* (Brown); *Lampropeltis alterna* (Brown); *Lampropeltis getulus brooksi* Barbour; *Stilosoma extenuatum* Brown; *Ficimia streckeri* Taylor; *Coniophanes imperialis* (Baird); *Kinosternon bauri palmarum* Stejneger. In addition, some 90 plates of the snakes east of the Rockies are exhibited.

A type in Datura with extra-chromosomal material which in inheritance resembles a recessive: A. F. BLAKESLEE, A. G. AVERY and A. D. BERGNER. A chromosomal type in Datura has been synthesized by replacing a 23 24 chromosome by the modified chromosome 23 14 and the chromosomal fragment 24, which together compensate for the missing 23.24 chromosome. These chromosomes have been rendered homozygous to form a pure-breeding type $\left(\frac{\cdot 24}{23\ 14}\right)_2$ in which the 23 24 chromosome is lack-

ing and in which there is a double dose of extra 14 material The plant resembles the secondary 2n + 14·14 type called "Mealy," which also has two doses of extra 14 material but which does not breed true The addition of extra 14 material has relatively little influence upon the appearance of the plant affected In consequence, plants heterozygous for extra 14 material can be distinguished from normals only by those skilled in recognition of slight differences among Daturas and then only under exceptionally favorable conditions of growth The $\left(\frac{24}{23\cdot 14}\right)_2$ type, however, which has two doses of extra 14 material, is readily recognized This latter type, if its chromosomal constitution were not known, might be classified as a recessive so far as its breeding behavior is concerned If crossed either way with a normal, the F_1 appears normal and the type is recovered in the F_2 generation Most pure breeding types with extra chromosomal material resemble dominant gene mutants in inheritance Thus the type $(2n + 2\ \ )_2$, in which a 2 half chromosome is translocated to the 11·12 chromosome, is readily recognized when heterozygous as well as when homozygous for the extra 2 material Under certain conditions the dominance appears to be complete, since heterozygous can not be distinguished from the homozygous individuals

Old and new criteria for determining the relationships of higher plants WALTER T SWINGLE The phylogenetic taxonomy of the higher plants has proved extraordinarily difficult to work out None of the criteria used for determining phylogenetic relationships are infallible, characters that have high classificatory value in one group may have little or no value in another group Every new criterion helps to indicate relationships *Criteria classified into Categories*—A Morphological (Categories I to IV), B Physiological (Categories V to VII) and C Genetical (VIII) Category I *General Morphology*, covers criterion 1, General Appearance of Plant, Gross Morphology and Color of Organs Category II *Special Morphology*, covers criterion 2, Flowers and Fruits 3 Inflorescences, Branches and Metamers, 4, Leaves, 5, Seeds, Fruits and Pollen Grains, 6, Leaf Traces and Stelar Structures, and 7, Embryo Sac, Endosperm and Young Embryo Category III *Anatomy and Cytology*, covers 8, Anatomy of Plant Organs, and 9, Number, Size and Shape of Chromosomes and other Cell Structures Category IV *Ontogeny*, covers 10, Germination of Seed, Development of Young Plant, and 11, Teratology, Abnormal Development of Plant Structures Category V *Physiology and Chemistry*, covers 12, Serological Diagnosis, and 13, Chemical Composition Category VI *Compatibility and Susceptibility*, covers 14, Tissue Compatibilities in Grafts and other Tissue Transplants, and 15, Host Susceptibility to Parasites Category VII *Ecology* covers 16, General Environmental Relations of Plants, 17, Physical Life History Requirements and Limitations, 18, Nutritional Requirements and Limitations, and 19, Special Adaptations of Plants to Environment Category VIII *Genetics*, covers 20, Cross Breeding Capabilities, 21, Cytogenetic Characters of Chromosomes and Grouping into Genoms, 22, Cytonomic States of Nuclear Association, 23, Effects of Pollen Parent on Endosperm (Xenia) and 24, Effects of Pollen Parent on Maternal Tissues (Metaxenia) Some of these criteria have been in use since the dawn of human history, several have come into use during the present century and two or three have been discovered during the last decade Studies of the higher plants made by using many or all of these criteria will undoubtedly lead to a much clearer picture than we now have as to their phylogeny Such studies will also be of great help in making use of remote relatives of our cultivated plants in creating hybrids of the newly discovered allopolyploid type These hybrids in many cases show superior vigor, hardiness and disease resistance

A simple factor affecting the velocity of ionic oxidation reduction reactions in aqueous solutions Equivalence of valence change PHILIP A SHAFFER Among the most elusive and obscure problems of chemistry are those concerning the specific velocity of reactions Modern theory of the subject, although elaborate, is inadequate Based chiefly on the concept of activation energy, it deals only with physical quantities which so far do not describe fully the characteristic *chemical* properties of atoms and molecules on which both reactions and their rates presumably depend It is therefore not surprising that present theory is able to predict the velocity of a given reaction only by interpolation from values determined by experiment, without experiment no prediction is possible Although to this extent apparently successful with many reactions, it seems doubtful whether the concept of activation energy alone, however elaborately treated, can account for the wide differences in velocity found among a large group of supposedly similar reactions of a simpler sort, namely, ionic oxidation reduction reactions in aqueous solution While many ionic reactions are immeasurably rapid and are therefore said to require only little energy for activation, others involving the same reactants with different partners may be immeasurably slow There are many cases where ionic substances, both demonstrably "active," refuse to react (or react slowly) in the same solution, but react rapidly when separated in the form of an electrolytic cell or in the presence of suitable catalysts To account for this rather surprising behavior some other ideas beside that of activation energy appear to be necessary In seeking for an explanation, a number of oxidation reduction reactions between both inorganic and some organic substances have been roughly surveyed as to their relative rates It appears to be a somewhat general, although not universal rule, that where the "permissible" (and dynamically possible) valence-change of oxidant and reductant is equal—bimolecular reaction being therefore possible—the reaction is relatively rapid, while for cases in which the valence changes are unequal the reaction rates are much slower, apparently for the reason that reaction must await for the proper three body collision—a much less frequent event Support for this simple interpretation is afforded by the fact that certain catalysts

of the latter class of reactions are capable of mediating the oddness of valence-change by undergoing both, thus permitting reaction to occur by a sequence of bimolecular steps In several cases observed catalytic activity of the substance has led to the discovery of an additional valence state not previously suspected It seems probable that mediation of an odd valence change is a common mechanism for the action of catalysts in oxidation reduction reactions It is thought that this idea may account for the necessity for certain catalysts in biological oxidations, it appears to give new significance to the property of "two step" oxidation reduction possessed by various respiratory pigments, the theoretical analysis of which has been given by Michaelis

Solutions of the wave equation in spheroidal coordinates J A STRATTON (introduced by John C Slater) It has been shown that the Schrodinger equation, including the wave equation as a special case, is separable in eleven systems of coordinates only Of these eleven systems, three alone have been investigated with a thoroughness sufficient to meet all the demands of physical problems Of those remaining, three more are of outstanding practical importance The functions of the elliptic cylinder, the prolate spheroid and the oblate spheroid include as special cases the functions of the sphere and the circular cylinder, and are adapted to problems involving slits and flat strips, circular disks and rods of finite length It is the object of the present investigation to establish the properties of these functions in a detail approaching that known for the Bessel and Legendre functions On separation of the wave equation in any of the three coordinate systems named it appears that both angular and radial functions satisfy a differential equation of the type $(1-z^2)w''-2(a+1)zw'+(b-c^2z^2)w=0$ wherein the separation constant b is restricted to characteristic values such that one particular solution exists which is finite at the regular points $z=\pm 1$ Asymptotic solutions appropriate to the region of large values of z are defined and normalized in the manner most convenient for physical problems In diffraction problems, an expansion of a plane wave in terms of the functions of the elliptic cylinder or spheroid is required, and this, as well as the nature of the usual boundary conditions, necessitates a knowledge of the behavior of the functions of both the first and second kind in the neighborhood of $z=0$ The analytic continuation of both asymptotic solutions into the origin is attained by means of contour integrals and thus expansions of the two independent solutions appropriate to all regions of the z plane are available, together with their analytic connections

Arc spectra of hydrogen and deuterium R W WOOD and G H DIEKE It was shown many years ago by Kiuti that in the secondary or molecular spectrum of a hydrogen arc between tungsten electrodes, many of the strong lines obtained with the hydrogen vacuum tube were missing, and others were relatively strong The matter has now been more fully investigated with higher dispersion, and is discussed from the theoretical standpoint

Remarks on the measurement of the magnetic moment of the proton OTTO STERN (by invitation) *Spectroscopic method* By measuring the frequency change of a spectral line in the magnetic field the energy change of the atom $\Delta E=\mu H=h\Delta\nu$ is determined In fact only the difference in the energy changes of two states of the atom can be measured in this way At least one of the two states must be an excited one The *molecular ray method* on the contrary, allows the measurement of the magnetic moment of a single state, the normal state of the atom This is valuable not only for the treatment of some fundamental problems (space quantization, etc), but also for the problem of measuring very small moments Therefore, it is possible to measure the magnetic moment of the proton ($\mu\approx 10^{-23}$ e s u) a problem not yet solved by the spectroscopic method The reason for this is a fundamental one, the uncertainty principle of the wave mechanics[1] This principle stipulates that the uncertainty δE of the measurement of the energy is connected with the length of time of the measurement δt by the relation $\delta E \cdot \delta t\approx h$ Since the lifetime of an excited state of the H atom is less than 10^{-8} seconds, the uncertainty of the energy measurement is $\delta E \approx \frac{6 \cdot 10^{-27}}{10^{-8}} = 6 \cdot 10^{-19}$ erg The energy change in the magnetic field, due to the magnetic moment of the proton, is $\Delta E=\mu H\approx 10^{-23} \cdot 6 \cdot 10^{4} = 6 \cdot 10^{-19}$ erg in a field of $6 \cdot 10^{4}$ gauss This means that even in such a strong field $\Delta E\approx\delta E$, or the uncertainty in the measurement is as large as the quantity to be measured Under the conditions of the molecular ray method, δt corresponds to the time during which the atom is in the magnetic field, at least 10^{-4} seconds under the usual conditions This means that in this case the uncertainty of the measurement δL is only 10^{-4} of the quantity itself ΔE The actual measurements, carried out first in the Hamburg Institut of Physical Chemistry, fell very much short of this limit of error Nevertheless, the measurements gave a very interesting result, about 2½ nuclear magnetons Dirac's theory, very well confirmed in the case of the electron, predicts a value of 1 nuclear magneton for the proton

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SIMPLIFIED EQUIPMENT OF SMOKING KYMOGRAPH DRUMS

WHERE no separate room can be set aside for smoking kymograph drums, both the experimenter and the instructor is confronted with the necessity of smearing the paint and equipment of the laboratory as well as the clothing of the students with the excess soot The former difficulty is also one of the frequent and serious

[1] For the spectroscopic problem, *cf* W V Houston and Y M Hsieh, *Phys Rev*, 45 263, 1934

objections raised to psychological work in state hospitals and institutions. The equipment described in this note obviates both of these objections and its simple construction commends it for general use. A line drawing of it is shown in Fig. 1.

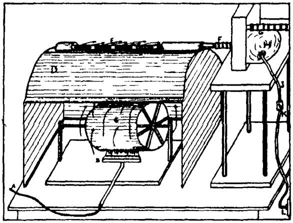

FIG. 1. Drawing of a simple form of equipment for smoking kymograph drums.

The essential parts of the equipment consist of a hood (D) made of about 22 gauge tin and a vacuum sweeper motor (H) mounted on a stand of suitable height and equipped with extension hose (G) which is furnished with the motor. The hood is made large enough to accommodate the drum on its stand (C). In the top are draught vent holes (E) through which the excess soot is drawn away from the flame (B). The soot from the hood is drawn into the intake of the motor by means of a short length of extension hose (F). It is then passed on through to the outlet of the motor and into the hose (G) which replaces the usual bag. The extension hose (G) can then be placed out through a convenient window and all excess soot is taken outside. No changes are made in the electrical connections of the motor (J), except to place a line switch (K) at a convenient place. The height of the motor stand and of the top of the hood depends on the height of the drum stand to be used.

The motor is obtained at any store dealing in used vacuum sweepers. They will also furnish, usually without extra charge, any reasonable length of hose. If carefully and competently chosen, the motor can be expected to give unlimited service after reconditioning. The model outlined here has been in use over three years without any expense for upkeep.

The entire equipment can be secured locally at a cost of about $10.00 to $12.00. The only objection that has appeared in three years of use is the noise made by the motor. This is, of course, similar to that made by a sweeper in ordinary household use. This particular model also works better when the gas is not previously passed through benzine, as is done in some laboratories. It has proved completely satisfactory as far as its main purpose is concerned, and is readily portable either from one room to another or from the laboratory to an outside institution.

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A PARAFFIN BLOCK COOLER FOR USE WITH THE MICROTOME[1]

IN the preparation of serial sections, it is desired to obtain paraffin ribbons that show little or no compression. Such a result with small blocks of tissue facilitates the enumeration of sections when this is a necessary prerequisite to mounting, and also greatly decreases the time entailed in spreading. When only a few sections are necessary, cooling the block on ice previous to cutting is the usual procedure, but for superior results in a long series a continuous supply of cold air is desired.

Foot and Strobell[2] in sectioning eggs of Allobophora devised an apparatus quite comparable to an air-conditioned room. The microtome is placed on a rubber sheet. The cooler, a double-chambered copper box, is superimposed, thus utilizing the rubber sheet as the bottom of the compartment. By means of a glass top that forms the upper surface of the inner chamber and arm holes in the side, one can operate the microtome *in situ* with full view of his movements. A freezing mixture of ice and salt placed between the two compartments allows for a reduction of temperature to twenty-five degrees Fahrenheit.

Grave and Glaser[3] utilized an apparatus that "is essentially a hollow truncated pyramid, open at both ends, and suspended in an inverted position from a standard, so adjusted that the lower end of the chute is at a convenient distance above the knife. At the upper end of the inverted pyramid, and surrounded by it, is a tray whose dimensions are less than those of the base of the chute. This tray is filled with crushed ice, and from one corner of it a drain leads the water to the escape from the lower end of the air channel."

With the idea of utilizing the principle of Grave and Glaser[2] but controlling the cold air supply, a cooler has been devised. The cooling chamber consists of a tin receptacle six inches in diameter and eight and one fourth inches in height. Copper tubing, one fourth inch in diameter, coiled within from the air inlet A, to the outlet B, serves as a medium for the passage of

[1] From the Department of Anatomy, The University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

[2] K. Foot and C. Strobell, *Biol. Bull.*, 9: 281–286, 1905.

[3] C. Grave and O. C. Glaser, *Biol. Bull.*, 19: 240–242, 1910.

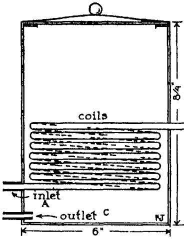

Fig 1

air throughout the cooling chamber The inner surface of the latter is painted with black asphaltum, while the exterior is overlaid with asbestos The protruding portion of the copper tubing forming the inlet A is connected by rubber tubing to a calcium chloride tube for the purpose of dehydration, and in turn to a compressed air supply The copper tubing, insulated with rubber, passing through the wall of the cooling chamber to form the outlet B, is bent at right angles horizontally, thus permitting direction of air at the surface of the block, and yet allowing for placing the cooler to one side and in front of the microtome The height of the tubing at this point is variable with the type of microtome employed, but should be so placed as to allow full utilization of the cold air supply If desirable, an outlet C, as a drain, may be inserted

In actual operation, the ice chamber is filled with cracked ice, ice and salt or other freezing mixtures For purposes of this laboratory, the former gave a temperature range sufficiently cool for cutting during the summer months The microtome and cooler are so oriented that the cold air emitted at the outlet B will play directly on the cutting surface of the preparation The distance of the former from the latter may be determined by the extent of cooling desired A few sections are cut without turning on the compressed air Having thus obtained the basis for a ribbon a gentle stream of air is directed at the block and cutting is resumed

Contrary to an opinion that may occur to the reader, the air draft created does not hinder manipulation During a period of seven months use no difficulties were experienced with electrification of the paraffin ribbon

Germain Crossmon

SPECIAL ARTICLES

CRYSTALLINE CARBOXYPOLYPEPTIDASE

Carboxypolypeptidase splits the amide linkages of certain amino acid compounds, such as chloracetyl tyrosine, tyrosyl tyrosine and leucyl glycyl tyrosine, with the liberation in each case of an amino acid which in the intact compound has a free carboxyl group [1] I have isolated from bovine pancreas a crystalline water insoluble protein which attacks chloracetyl tyrosine Peptic digests are also attacked even in the presence of formaldehyde Other substrates have not been tested, so it is not yet certain that all the supposed substrates of carboxypolypeptidase are digested by a single enzyme It may be that what has hitherto been called carboxypolypeptidase is a group of different enzymes

Recrystallization of the globulin does not change its carboxypolypeptidase activity but frees it of proteinase Heating a solution of the crystalline globulin until half the protein is coagulated results in destruction of half the solution's activity These facts are strong but not conclusive evidence that the crystalline protein is identical with the enzyme whose activity has been measured A solution of the crystalline globulin diluted to attack chloracetyl tyrosine at the same rate as a given crude extract of pancreas likewise attacks a formolized peptic digest at the same rate as the crude extract This fact is strong evidence that the enzyme in the crude extract which attacks chloracetyl tyrosine is likewise responsible for the digestion of the formolized peptic digest Finally, the fact that the crystalline globulin digests a peptic digest even in the presence of formaldehyde proves that the presence of the free amino groups of neither enzyme nor substrate is essential for carboxypolypeptidase activity No proteolytic enzyme of the pancreas other than carboxypolypeptidase is known to be active in the presence of formaldehyde

In outline the preparation of the crystals is as follows To the spontaneously activated turbid fluid which exudes when frozen pancreas is allowed to stand overnight at 5° C 5 N acetic acid is added until the solution is green to brom cresol green The acid solution is kept at 37° C for two hours and the clotted suspended matter is filtered off The filtrate is diluted with ten times its volume of water The resulting precipitate is allowed to settle, the supernatant solution is rejected and the suspension is filtered Water is added to the precipitate to give a suspension twice as active as the original turbid fluid and then 0 2 M

[1] E Waldschmidt Leitz, *Physiol Rev*, 11 358, 1931, M Bergmann, Science, 79 439, 1934

$Ba(OH)_2$ is added until the suspension is pink to phenolphthalein Whereas NaOH would dissolve all the dilution precipitate under these conditions, $Ba(OH)_2$ dissolves only a part of the protein but all the carboxypolypeptidase After removal by centrifugation of the undissolved protein 1 N acetic acid is added to the supernatant solution until the solution is orange to phenol red The globulin crystals thereupon appear, promptly if the solution is seeded, slowly if it is not The protein can be dissolved with NaOH and recrystallized by neutralization

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THE EFFECTS OF PITUITARY IMPLANTS AND EXTRACTS ON THE GENITAL SYSTEM OF THE LIZARD

OVULATION has been induced in a serpent *Xenodon merrimi* six days after five homoplastic whole pituitaries were implanted [1] Hypertrophy of the genital system has been produced in Lacerta[2] and in young alligators[3] by means of mammalian pituitary extracts Removal of the pituitary causes atresia in the testes of the garter snake (*Thamnophilis sirtalis* and *Thamnophilis radix*) followed by a partial restoration to normal when pituitaries are implanted [4]

In a series of experiments carried on between October 30, 1933, and April 4, 1934, fifty five females and seventy nine males of *Anolis carolinensis* received injections of Antuitrin S (human pregnancy urine extract, Parke Davis), while twenty five females and twenty five males received injections of sheep pituitary (whole pituitary extract of Parke Davis) Approximately fifty animals were kept as controls A single dose with either extract was not more than 02 cc diluted with two or three volumes of cold blooded Ringer This proved to be the maximum dose that was safe to use

The males responded very completely to both extracts and could be very easily distinguished from controls in the following particulars (1) The dorsal crest along the neck and back was raised, often to the height of an eighth of an inch (2) The hemipenes could be everted (3) The testes were often enlarged to two or three times the size of those of controls (4) The epididymis and vas deferens were always greatly enlarged In an extreme case of hypertrophy a single loop of the epididymis was found to be at least fourteen times the diameter of that of a control which was killed at the same time. (5) Spermatozoa were found in the epididymis after the fourth daily injection (6) The vas eferens was slightly enlarged (7) Courtship and fighting were a common activity on every sunny day during winter and early spring

In regard to the females, hypertrophy of the ovaries and oviducts was produced with both Antuitrin S and sheep pituitary, but actual egg laying resulted only with the latter extract Some females which were injected with sheep pituitary retained mature ova within the ovaries These eggs were slowly resorbed during the ensuing three months Neither the ovaries nor oviducts enlarged as much with Antuitrin S as with the sheep extract After twelve injections of sheep pituitary, two eggs were laid on March 23 and three more the next day A sixth egg was laid on April 11 The first egg to be laid by any of the controls was on April 18 and a second egg on May 8 No more eggs were laid by controls until June, July and August

The metabolism of injected animals was greater than that of controls as was shown by an increase both in appetite and in the amount of food eaten Also, food was required oftener General activity and speed of movement were undoubtedly greater Moulting occurred more frequently

The after effects were noticeable Four months after the last injection found many of the treated lizards to be persistently thin, although on an average they ate more than the controls A few died apparently of starvation while controls, which had received approximately the same amount of food, lived in a perfectly healthy condition

Complete details concerning these experiments with mammalian pituitary extracts are to be reported later

It may be of further interest to state that in connection with some experiments with pituitary implantations in *Anolis carolinensis* (December 21, 1933, to April 14, 1934), one female which received four whole pituitaries (taken from males of the same species) failed to ovulate, but the genital system was approximately twice the size of that of controls Out of three females which received five similar homoplastic implants, two died before ovulation (autopsy showed hypertrophy of the genital system) but the remaining female actually laid two eggs, one on March 24 and another four days later Another female, which received three frog pituitaries, laid an egg on April 12

When the two females last mentioned were killed (April 14) they showed mature ova just ready to leave the ovary Only one ovary in each female, however, contained a mature ovum, although the oviducts

[1] B A Houssay, *Compt Rend Soc Biol*, 106 377–378, 1931

[2] M Herlant *Arch de Biol* 44 347, 1933

[3] T R Forbes, *Proc Soc Exp Biol Med*, 31 1129, 1934

[4] W H Schaefer, *Proc Soc Exp Biol Med*, 30 1363–1365 1933

on both sides were equal in size and enlarged to the maximum condition necessary for ovulation None of the twenty five controls ovulated during the period of this investigation

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DISCREPANCIES IN THE VALUE OF THE AEROBIC REDUCING INTENSITY OF THE YEAST CELL AND STARFISH EGG[1]

THE recent appearance of a paper by Green[2] on the oxidation reduction potentials of cytochrome c has brought to light a discrepancy in the value of the aerobic reducing intensity of Fleischmann's yeast cells as estimated (a) from the reactions of penetrating oxidation reduction indicators of the Clark series, (b) from the reaction of the naturally occurring oxidation reduction system cytochrome c

As Keilin[3] has reported, well aerated yeast shows none of the bands of reduced cytochrome For cyto chrome c Green[4] has reported E_0' values of about + 0 125 v for pH values between 4 59 and 7 14 Since in aerated yeast all components of cytochrome are so far oxidized that the bands of the reduced form are not detectable, we may safely assume that cytochrome c is at least 90 per cent oxidized Assuming for the yeast cell a pH value between 6 0 and 7 0 and taking for cytochrome c within the yeast cell an E_0 value of + 0 125 v, we get for the aerobic reducing intensity of aerated yeast cells a value equal to or greater than + 0 18 v (0 125 plus 0 058 $\log_{10}$ 9)

The stated value of the aerobic reducing intensity of these cells as estimated from the reaction of pene trating oxidation reduction indicators, will depend upon the intracellular pH which we assign to the yeast cell For a very large number of diverse cells Cham bers and his collaborators[5] have found a cytoplasmic pH of 6 8 ± 0 2 Fleischmann's yeast cells stained with methyl red or propyl red take on the alkaline coloration of these dyes, indicating a pH value equal to or greater than 5 8 with methyl red, and equal to or greater than 6 2 with propyl red It would certainly seem safe, therefore, to assume for the cytoplasm of the yeast cell a pH equal to or greater than 6 0

In Table I is shown in tabular form the values of the aerobic reducing intensity of Fleischmann's yeast cells, as estimated from the reaction of penetrating oxidation reduction indicators (previously reported by Beck and Robin[6]) if we assign to the cytoplasm of the yeast cell pH values of 6 0 and 7 0, respectively

TABLE I

Indi cator	E_0' values pH 6 0	E_0' values pH 7 0	Condition in aerated yeast cells	Estimated value for aerobic re ducing intensity pH 6 0	Estimated value for aerobic re ducing intensity pH 7 0
Toluy lene blue	0 162	0 115	Reduced	0 124 or less(1)	0 077 or less(1)
Thionin	0 092	0 062	Partially reduced at	0 092(2) at	0 062(2)
Cresyl blue	0 089	0 047	Largely oxidized	0 103 or more(3)	0 061 or more(3)
Methy lene blue	0 047	0 011	Largely oxidized	0 061 or more(3)	0 025 or more(3)

(1) Potential values estimated on assumption that toluylene blue is at least 95 per cent reduced
(2) Potential values estimated on assumption that thionin is 50 per cent reduced
(3) Potential values estimated on assumption that cresyl blue and methylene blue are at least 75 per cent oxidized

It is quite evident that whether we assume a cyto plasmic pH value of 6 0 or the much more probable value of 7 0 the aerobic reducing intensity of the yeast cell, as estimated with the penetrating indicators, is decidedly more negative than the value which we esti mate from the reaction of cytochrome

Chambers, Pollack and Cohen[7] had noted a similar though smaller discrepancy in their microinjection experiments on starfish and sand dollar eggs K_4 indigo tetrasulphonate E_0' value at pH 7 0 of − 0 047 v, is not perceptibly reduced aerobically, ethyl Capri blue, E_0' value at pH 7 0 of 0 072 v, is definitely partially reduced This discrepancy is in all probabil ity due to the fact that sulfonated dyes are reduced by the cellular dehydrogenase systems much more slowly than are basic dyes (as ethyl Capri blue) hav ing E_0' values of the same order

It is felt that these discrepancies should be stressed, since they indicate that at least under aerobic condi tions the underlying kinetic factors which determine whether a given oxidation reduction indicator, or other reversible oxidation reduction system, shall be present within a living cell chiefly in the oxidized or the reduced state, are affected not only by the oxida tion reduction potential of the indicator (or system) but also by its chemical nature The failure of most workers to note similar discrepancies is probably due to the fact that most of the indicators having oxida

[1] From the Lilly Research Laboratories, Marine Bio logical Laboratory, Woods Hole, Mass
[2] D E Green, *Proc Roy Soc B*, 114 423, 1934
[3] D Keilin, "Ergebnisse der Enzymforschung," II S 239 Leipzig, Germany Akademische Verlagsgesell schaft, 1933
[4] *Loc cit*
[5] R Chambers, *Bull Nat Research Council*, 69 37, 1929
[6] L V Beck and J P Robin, *Jour Cell and Comp Physiol*, 4 527, 1934
[7] R Chambers, H Pollack and B Cohen, *Jour Exp Biol*, 6 229, 1929

tion reduction potentials in the neighborhood of the ones showing partial reduction are closely related chemically to the latter.

LYLE V. BECK

ROLLER CANARY SONG PRODUCED WITHOUT LEARNING FROM EXTERNAL SOURCES

SINCE May 31, 1934, twelve roller canaries have been born and reared in soundproof cages, without hearing a song from any non-isolated bird. Eight are males, and four are females. Daily recordings of their vocal responses have been made on aluminum disks, motion picture films, or strobophotographic records.

The contest roller canary song consists of vocal effects known as rolls and tours. They are distinguished on the basis of sonance, or successive auditory fusion. In a roll, the successive pitch changes are perceived as unitary, whereas in the tour the patterns are perceived as discrete units. Physically, the distinction is one of rate of the successive patterns, the rolls having sufficient rapidity to be fused in auditory perception.

The basic song consists of a sequence of hollow roll, hollow bell, schockel, flutes and water roll. The first four, when graphed for rate of successive patterns, show a decreasing rate resembling a typical muscular fatigue curve. The rolls and tours of the main sequence are added to, substituted for or embellished by individual birds. The added effects are the bass roll, glucke, glucke roll, water glucke, schockel, deep bubbling water tour, bell roll, bell tour and bell glucke. It is rare that a single bird has all the effects in his song. The number generally varies from five to ten.

By January 7, 1935, the date of this writing, all the isolated males had produced recognizable effects of the roller canary song. These data have been checked by Mr. Frank H. Bires, of Whittier, California, an outstanding contest judge.

Nest 1. Males 51, 52 and 53, each aged 212 days, produced a hollow roll, schockel, flutes and water roll. Males 52 and 53 produced a hollow bell, and Male 51 a bass roll, bell roll and bell tour.

Nest 2. Male 24, aged 210 days, produced a schockel, flutes, water roll, hollow roll, deep bubbling water tour and water glucke.

Nest 3. Males 56, 57 and 58, each aged 163 days, sang a water roll and flutes. Males 56 and 57 developed a glucke and bell roll. Males 56 and 58 produced a hollow roll and schockel. Males 57 and 58 produced a water glucke, Male 56 the only bell tour in the nest, and Male 58 the only water glucke which has yet appeared in Nest 3.

Nest 4. Male 60, aged 224 days, produced a glucke, flutes, bass roll, hollow roll, hollow bell and bell glucke.

Taken together, the isolated birds produced all the effects. Four of them, Males 51, 52, 53 and 60, had from four to six effects when breaking into the mature roller song for the first time. They were subjected to inhibiting factors incidental to the original experiment, possibly the excessive heat, or, perhaps in the case of the first three, the fighting which often occurs when males are in the same cage. The other four, Males 24, 56, 57 and 58, developed one roll and tour after another from their baby song. The latter three were isolated at the first appearance of baby song, before any roll or tour appeared. The baby song is for the most part a nonsense melody of choppy notes covering a wide pitch range. The earliest baby song appeared at 60 days and the latest at 149 days.

Rolls appeared earliest in the cases of Males 51 and 52, specifically, at the age of 110 days. The slowest to develop a roll was from the same nest, Male 53, who was 179 days old at the time.

Males 24, 51, 56, 57, 58 and 60 heard no rolls or tours of any kind prior to producing them. Males 51 and 52 heard each other. Male 53 heard the song of Male 24.

The females have produced only a characteristic chirp and simple series of call notes. According to professional canary breeders, the female rarely has any of the rolls and tours. With this assurance, the mothers in this study were left with their young until weaned, the period varying from 25 to 40 days. The notes of the canary hens were observed and recorded, and no semblance of rolls or tours appeared. The males used in breeding were removed from the soundproof cages before the female was placed with the eggs. The eggs were removed from the breeding cage daily until all had been laid.

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BAILEY, W. N. *Generalized Hypergeometric Series.* Pp. 108. Cambridge University Press, Macmillan. $2.00.
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SCIENCE

VOL. 81 FRIDAY, MAY 17, 1935 No. 2107

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE MECHANISM OF ENZYME ACTIONS[1]

By Dr. K. GEORGE FALK

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IN making up the program of the symposium on enzymes for this meeting, the speaker was asked to discuss the mechanism of enzyme actions. The ground to be covered was not further specified. In thinking over the possible topics to be considered, it was soon evident that everything related to an enzyme action might be included, but this would make the treatment a hopeless one. Perhaps it would be as well not to attempt an exhaustive review, but rather to present some personal conclusions and relations based upon the experimental and theoretical work and study over a considerable period of time, as time is reckoned by the individual.

Ten years ago, in a monograph on enzyme action, the speaker wrote a chapter on the mechanisms of such actions. The conclusions presented there in rather elementary fashion have been supplemented since, but unfortunately, the relations have not been simplified. Rather the complexities of the problems have become more generally recognized, and while the simpler relations may still be said to hold, they furnish only the beginnings of the real study of the problem of the mechanisms of such actions.

It would be rather easy to present a number of facts of enzyme actions and to draw conclusions limited to the cases in point from them. To such an audience as this the facts of enzyme actions are known. To repeat them is unnecessary and also boring. To present some more general relations and views may perhaps be useful, more for the purpose of raising questions than of answering them.

[1] Presented at the Symposium on the Chemistry of the Enzymes held by the Divisions of Agricultural and Food Chemistry and of Biological Chemistry of the American Chemical Society, Cleveland, Ohio, September 11, 1934.

In the first place, what is meant by mechanism of enzyme actions? Enzyme actions are chemical actions, enzymes are materials causing chemical changes in various substances This raises the question of the mechanism of chemical actions and reactions in general In a monograph published six years ago by the American Chemical Society, F O Rice[2] discussed the "Mechanism of Homogeneous Organic Reactions" He brought out clearly the difficulties involved in such studies and stated[3] "It is not a matter for discouragement that the mechanism of organic reactions is, in great part, so uncertain It does not seem likely, however, that there will be any remarkable advance by proceeding along classical lines, and we may look for this only through the development of some new method In view of the more complex nature of enzyme reactions involving substances in the colloidal state, etc in comparison with the homogeneous organic reactions which were treated by Rice, the outlook for understanding the mechanism of enzyme actions is not hopeful to say the least

Enzyme actions have been and are included in the group of catalytic actions This does not add anything to the understanding either of enzyme actions or of catalytic actions, so nothing more will be said of this relationship, or comparison, or classification, or whatever it may be called

Having put forward the worst imaginable view, it will now be possible to go ahead with the statements of some of the relationships which have been proposed

To any one working with enzyme actions, the rates of chemical reactions or the amounts of changes in definite times, brought about or influenced by these enzymes, is the predominatingly important factor The accurate experimental determination and interpretation of such rates obviously is an essential feature of enzyme studies In an attempted evaluation of the results of such studies a most disconcerting fact appears There is no standardized method of studying these actions Apparently, most of those who have made extended studies of the velocities of enzyme actions have developed what may be called individualistic methods of carrying out the experiments or of presenting these results in mathematical form

The experimental methods of measuring enzyme changes may first be considered For a few enzyme actions the methods appear to be simple and have been generally adopted For most, however, individualism runs wild For example, for such a comparatively simple action as fat or ester hydrolysis, in the methods used, one chemist, apparently to fix conditions, adds a mixture of sodium oleate, calcium chloride and albumin to the enzyme material, another adds nothing at all but allows the acid formed progressively in the reaction to do what damage it may, one uses a stalagmometric method successfully, another is unable to obtain results with it, buffers of different compositions are added, although it is recognized that each such buffer may modify the action in its own way, and so on This list could be elaborated endlessly and with other enzymes All this may be said to have culminated in the protease work of Northrup, who uses twelve different methods of protease testing to determine similarities and differences in his crystalline protease preparations

Then, on the theoretical side, the most obvious way of handling an experimental series of results mathematically is to apply the reaction velocity equations to them The simple monomolecular reaction rate, involving the substrate, early was found to hold either not at all or only for limited ranges of change for many enzyme actions Then came modifications of this equation, factors added to account for the products of reaction combining with the enzyme and so removing it from the sphere of action, of the reaction taking place in steps, etc, all accounting or reproducing mathematically the changes within more or less limited ranges Terms to include adsorption were introduced Empirical terms were proposed The most extreme treatment was that of Nelson and Hitchcock[4] who developed an empirical equation, containing four constants, to reproduce the results on the hydrolysis of cane sugar by invertase Many of the equations suggested, both theoretical and quasi theoretical, are well known to those here to day

The following statement was made some years ago[5] "The three concepts—chemical reaction, chemical equation and mathematical equation—are supposed to describe the same phenomenon in any given case Actually they do so only as an ideal condition, and the possibility of deviation becomes greater with increasing complexity of the reactions and with decreasing care in the use of terms and expressions" Evidently, enzyme actions involving unknown enzyme materials and mixtures, on the one hand, and changes in complex materials, such as proteins, etc, on the other hand, are not readily amenable to simple theoretical treatment

What does all this mean? Is there any way out of this apparent muddle, if it is a muddle? First, it will be necessary to philosophize a little The measurements and studies were made by chemists of various kinds and degrees Now, it is possible to divide chemists into three groups There are, first, the self-starters, second, those who must be cranked occasionally, and third, those who must be towed their whole

[2] American Chemical Society, Monograph Series, Monograph No 39, Chemical Catalog Co., Inc New York
[3] Page 19

[4] *Journal American Chemical Society*, 43 26–32, 1921
[5] "The Chemistry of Enzyme Actions," 1924, p 36.

lives For the purposes in view, only the first two classes need be considered, the self-starters and the cranked The third group, the so called towees, add much at times to the vociferousness of the proceedings and help to fill the journals, but for a true study of the value of their concepts such mass action for once must be given small consideration Caution must be used in determining what methods are of real value

To what does all this lead? Different methods are used by different workers Each worker interprets his results from a different view point In the main this means that this branch of science is new and in the making The methods are not standardized, and it may be said that each contributor adds something to help build up the structure of enzyme actions For example, Levene[6] finds that hydrolysis of certain di peptides by hydrogen ion and by erepsin are based upon the same type of actions, Bergmann is following this up and extending these relations, while Wald schmidt-Leitz has been separating a number of pep tidases and is developing a branch of the subject whose implications are not by any means clear The hydroly sis of cane sugar by invertase perhaps the most care fully and most accurately studied of all enzyme actions, leaves much to be asked for, if a real knowledge of the mechanism of its action is desired

In general, the study of the kinetics of enzyme actions has not thrown any conclusive light on the mechanism of such changes Perhaps the only conclu sion which seems justified at present and which is widely accepted is that addition compounds of enzyme and substrate are formed which then break down to form the products of enzyme actions Such addition compounds have not been isolated as chemical indi viduals The evidence for their presence is indirect and to that extent perhaps doubtful, but to assume their presence is useful and possibly true

Can anything further be said of the mechanism of enzyme actions? As is well known, because of the nature of the materials, the experimental study is extremely difficult However, it is desired to present some views, which are perhaps personal, but which rep resent, at least to one chemist, some of the directions which enzyme studies are taking

In the first place, a real and great advance has been made in the obtaining of enzyme materials as crystal line proteins of constant properties, first by Sumner for urease, and then by Northrop for pepsin and trypsin and by Sherman for amylase This part of the subject of enzymes does not properly come under the topic of the mechanism of such actions Indirectly it will play a most important part, as it will be pos sible to work with more definite materials It also has a bearing upon another phase of the enzyme prob lem to be discussed presently The fact that these enzyme preparations are protein in character and in fact have been considered to be pure proteins, is a matter which can not be overlooked At various times the question was raised whether protein material was a necessary constituent of the active enzyme Careful experimental studies are required to throw light on these questions For example, for the enzyme pepsin, the view was advanced recently that the active enzyme was not necessarily protein but could be transferred from one protein substance to another This view was shown to be erroneous and as far as evidence is at present available, these crystalline proteins act as the enzymes What the chemical composition of other enzymes may prove to be can not be foretold It would seem that lipases and esterases are also protein in composition, and that at the other extreme is inver tase, which has been found always to contain nitrogen, although possibly to only a small percentage even in its most highly purified state It is of interest that the two enzymes, lipase and invertase, at opposite extremes as far as chemical composition is concerned have just been brought together with regard to certain relations involving the mechanisms of their actions This rela tionship will be considered presently

The second point of advance to which it is desired to draw attention has to do with the influence of added substances on enzyme actions Added substances can modify many chemical reactions and especially the velocities of the reactions It is therefore not surpris ing that added substances should modify enzyme actions most profoundly in many instances If this were all that were involved—a listing of enzyme actions whose velocities were changed—there would be little or no justification for presenting these relations here It is desired, however, to present a point of view which is based upon some of these relations, a point of view which some believe may aid in throwing light on the meaning and hence the mechanism of enzyme actions

In an extended investigation[7] of lipase or esterase actions of extracts of a number of tissues and tumors of different animals the ester hydrolyzing actions on a number of different simple esters were determined under standardized conditions Any one tissue gave definite, reproducible amounts of relative hydrolyses on these esters under the definite conditions That is to say, if the tissue hydrolyzed twice as much of one ester as of another in one case, it did so in every experi ment Different tissues gave different amounts of the relative hydrolyses, so that it was possible in a number of cases to identify the tissue by means of the relative ester-hydrolyzing actions of its extract Added pro teins did not modify these relative actions, nor did

[6] P A Levene and H S Simms, *Jour Biol Chem*, 62 711, 1925

[7] K G Falk and associates in various publications.

mixing two tissue extracts modify the actions which were found to be additive in these cases If, however, a highly active preparation, such as pancreas extract, was tested alone, and then after the addition of different proteins, it was found that one protein would increase the hydrolytic action on one ester and another protein the hydrolytic action on another ester There was a selective or directive influence on the action of the enzyme due to these added proteins Such relations were clearly pointed out in 1925 by Platt and Dawson[8] and extended recently[9] It seems that with impure enzyme preparations the proteins and perhaps other substances present interfere with the influence of added protein With purer enzyme, added protein exerts a specific directive effect Similar results are being reported by Nelson and Saul with invertase, in a paper which is appearing this week in the September issue of the *Journal of the American Chemical Society* Here, only amounts of actions are involved, but the experimental methods permit of a high order of accuracy The hydrolytic action on cane sugar of highly purified invertase at pH 3 0 is increased by added protein The action of crude invertase is not influenced by such added protein

It is possible to speculate endlessly about the meaning and significance of these results Undoubtedly, they are of the highest importance for the proper understanding of the mechanism of enzyme actions, especially since it is probable that other enzyme actions will be found to show similar relations Only a few points will be mentioned and these only sketchily Certain phenomena of enzyme behavior have been explained by assuming the active enzyme to be a definite chemical grouping or part of a molecule stabilized by the remainder of the generally colloidal molecule This view has been widely publicized in recent years Some remarks may perhaps be permitted in this connection In the first place, Sumner[10] pointed out the indefiniteness of this point of view, which is flexible enough to meet any number of experimental results Secondly, this point of view is not of recent origin It seems to be the most obvious way of looking at the facts of enzyme actions chemically It was put forward by Perrin[11] in 1905, by Matthews and Glenn[12] in 1911, by Rohmann and Shmanine[13] in 191_, by the speaker[14] in 1918, by Willstatter[15] in 1922, and possibly by a number of others whose publications have been overlooked

It is a convenient way of thinking about the phenomena, but in itself is quite incomplete This raises the next question What might be the true nature of the combination between enzyme material and proteins which may be added or which are already present? Apparently the classical valence theory is inadequate To call the compounds "adsorption compounds" covers a volume of ignorance It is to be hoped that a view of chemical combination, possibly an outgrowth of the older valence theories, possibly a development of energy relationships and including the quantum theory in some form, will develop which will permit a rational formulation and description of these combinations

The mechanism of enzyme actions, as a rule, is taken to apply to simplified enzyme actions in the laboratory There is, however, a more profound view which may be taken That is, the mechanism of enzyme actions in the living organism may be considered Following the discussion of the influence of proteins on such different enzymes as lipase and invertase, it is evident that enzymes in every living organism must be influenced by the apparently inactive materials present Sometimes these influences or substances may exert directive actions, as with proteins on lipase, sometimes they may increase the actions as shown with proteins on invertase under the special conditions or with proteins on the hydrolyzing action of papain on glyceryl triacetate,[16] sometimes the actions may be decreased, and finally the possible action of one enzyme on another in the living organism must be considered

The enzyme in the living organism never acts alone or in a pure state, the external factors play a possibly predominating rôle Perhaps the enzyme may be called the hereditary factor, and what actually occurs in any given case depends upon the other substances present or the environment This is an interesting thought to play with but must not as yet be taken too seriously The mechanism of enzyme actions in the living organism offers a vast field for study A beginning has been made Time permits only a reference In the breakdown of glucose by yeast, the various steps in the process whereby different products are obtained under different conditions are gradually being elucidated The scheme of Neuberg[17] and quite recently that of Meyerhof and Kiessling[18] are undoubtedly familiar Here, a number of enzyme actions are involved and the possible complications are many, as

[8] *Biochem Jour*, 19 869, 1925
[9] K G Falk, *Jour Biol Chem*, 96 53, 1932
[10] SCIENCE, 78 335, 1933
[11] J Perrin, *Jour Chim Physique*, 3 50, 1905
[12] A P Mathews and T H Glenn, *Jour Biol Chem*, 9 29 1911
[13] F Rohmann and T Shmanine, *Biochem Zeit* 42 235, 1912
[14] K G Falk, SCIENCE, 47 423, 1918
[15] R Willstätter, *Ber Chem Ges*, 55B, 3601, 1922
[16] K G Falk, *Jour Biol Chem*, 103 363, 1933
[17] *Cf* the review by W Fuchs, *Sammlung chemischer und chemisch technischer Vorträge*, 27 1, 1922
[18] O Meyerhof and W Kiessling, *Biochem Z*, 267, 313–48, 1934

you all know Such studies, the results of which can be carried over to glucose breakdown in bacterial metabolism with necessary modification for any given case, and then perhaps brought into relation to muscle metabolism, would be a real triumph for a more useful understanding of the mechanism of such actions

It would be possible to go on indefinitely in this strain However, just one more thought will be presented One of the points which it is desired to emphasize here is the action of added substances on enzyme actions In other words, in these phenomena of living matter and of life processes it is the system as a whole which must be considered This thought is not new, but it is frequently overlooked or ignored, possibly because of the aim to make the study of chemical phenomena objective as far as possible In another field of chemistry, the simple ionic theory which treated of ions as independent entities has come to be modified to include the properties and actions of the solvent, of the ions on each other, of the influence of non ionized substances on the properties of the solvent and of the ions, etc It would be possible to give many other chemical illustrations, especially from the field of organic reactions In every case for a proper understanding of the reaction, all the factors and their interrelationships must be included It is therefore obvious that in the complex mixtures of living matter the reciprocal influences of the constituents must be considered For life processes, therefore, the understanding of the functioning of any one of the parts, and consequently also of the functioning of the whole, must necessarily treat of the system as a whole This point of view is in contradistinction to the present trend of physics, to work down toward the ultimate particles of energy or matter These two aims are not in contradiction, both are needed for a complete understanding of the phenomena involved But further, in considering the system as a whole and the influences of various substances on enzyme actions and the surprising results obtained at times, it might appear as if these studies are being developed from the view of "Emergent Evolution" Although the latter might perhaps be considered as a philosophy of ignorance, yet it sets definite problems and raises questions which may or may not be answerable

If the mechanism of enzyme actions were better understood, it would be an approach from the chemical side to the science of life itself The biologist is working toward simpler units of cell constituents Apparently, the genes are the simplest such units so far achieved Their molecular weights are perhaps in the neighborhood of 50 000 Davenport[19] considers that they probably are enzymes and presents views relative to their development and actions, analogous to some of the views presented here This is a tempting subject, and much of interest may be expected in this field in the near future

Finally, in considering the mechanism of enzyme actions as outlined here, several specific questions may be asked What is meant by "protein molecule" and by "pure protein"? What new concepts of forces or means of combination must be developed to account for the reactions observed? How do proteins and perhaps other substances, act in modifying certain enzyme actions? And finally what sort of a mechanism in the living organism permits of the continuity of the enzyme formations and actions which are needed for the continuance of the given life process?

OBITUARY

MICHAEL IDVORSKY PUPIN

In the small village of Idvor, not far from Belgrade, in the Austrian province of Banat, now a part of Yugoslavia, Michael Idvorsky Pupin was born on the fourth day of October, 1858

His parents, Constantine and Olympiada, were Serbian peasants who could neither read nor write, they were prosperous and highly esteemed members of the community From them he inherited a remarkably strong physique, an exceptional mental endowment and an oriental imagination

His formal education was begun in the village school of Idvor, where he learned reading, writing and arithmetic, and was continued in the schools of Panchevo and Prague

Eventually, while a student in Prague, he became so incensed at the Teutonic oppression of the Slavs in Bohemia that he decided to emigrate to America, where, he had come to believe from what he had learned in the schools at Panchevo and Prague, real freedom was to be found, and where, he thought, a young immigrant might make his way to fortune

Late in March of the year 1874 he landed, practically penniless, as an immigrant in New York City Shortly after landing, in an encounter with a crowd of newsboys, whose gibes at his headgear, a red fez, had aroused his resentment to fighting pitch, he demonstrated his ability to take care of himself An onlooker, a Delaware farmer, impressed by his performance, offered him a job on his farm, which he declined, since his duties would have included the milking of cows, which in accordance with Serbian tradition was a job for women Another offer of a job, on a Delaware farm, bearing a satisfactory stamp

[19] C B Davenport, *Scientific Monthly*, August, 1934, pp 104–108

of masculinity, was presently made him and was accepted

His job was to assist in the cultivation of the land by driving a pair of mules Presently, a young woman of the farmer's family interested herself in his welfare, and under her tutelage he rapidly acquired a considerable knowledge of the English language and some acquaintance with American history and customs

After a few weeks he set forth on a search for new experiences and in the course of a few days he obtained another farm job, driving a pair of mules, in southern Maryland After a month he left it and returned to New York City, where he thought, his *chances for advancement would be better than on a* farm

It was summer in the year 1874, and the country was still in the midst of the depression which started with the financial panic of 1873 Thousands of unemployed men patrolled the streets in search of jobs, and for many days Michael Pupin was one of these In the course of time he found work doing odd jobs, such as transferring coal from sidewalks to cellar bins, and painting cellar walls Through the winter of 1874–5 in one way or another he managed to pay his room rent and provide himself with fairly regular meals though sometimes a meal was nothing more than 'a bowl of soup and a chunk of brown bread"

Eventually he found steady employment in the New England Cracker Factory in Cortlandt Street Here, among the employees of the factory he made two friends who exerted no little influence on his career These were Jim the boiler engineer, a man with little education but nevertheless a philosopher and a wise counsellor, and Bilharz, a man with a fine education, particularly in the classics, but broken in spirit through some misfortune, and reduced to his present lowly employment These friends encouraged him to prepare himself for college This he did by studying Greek and Latin grammar in his spare time under the guidance of Bilharz, attendance at the night classes held in Cooper Union and later by full time attendance at the Adelphi Academy in Brooklyn In the fall of the year 1879 he passed with high standing his entrance examinations for Columbia College

In college he won scholastic distinction in Greek mathematics and physics He devoted comparatively little time to athletics, but through his prowess in wrestling and boxing he won the approbation of his classmates, who elected him president of the class for the junior year In his senior year his interest in physics was greatly stimulated through the lectures of Professor Ogden Rood, and he decided upon a scientific career

On the day preceding his graduation from Columbia in 1883 Michael Pupin received his naturalization papers and became an American citizen

Although he had been offered fellowships which would have enabled him to continue at Columbia for three years, he finally decided to go abroad for graduate study in physics

In June of the year 1883 he embarked for Europe, nine years after his arrival in America as an immigrant After a preliminary visit to Cambridge he returned to Idvor for his first visit home since his departure for Prague in the year 1872 He found his mother "much older, and much more beautiful" and, of course eager to hear from his own lips the story of his life and achievements in America His *father had died during his stay in Prague*

He returned to Cambridge in October and began his studies in mathematical physics under the preceptorship of the celebrated coach John Edward Routh, fellow of Peterhouse College Rayleigh and Stokes were lecturing on mathematical physics, but Pupin was not yet prepared for the advanced courses which they were giving Under Routh he acquired a mastery of dynamical methods which was an invaluable asset in his later scientific activities

After two years in Cambridge he decided to go to Berlin for laboratory work under the direction of the celebrated von Helmholtz Fortunately, at this time Pupin was offered by President Barnard of Columbia a John Tyndall fellowship He accepted without delay, and thus became the first John Tyndall fellow

In October 1885, he arrived in Berlin with letters of introduction from President Barnard and Tyndall, and was kindly received by Helmholtz During his first year in Berlin he attended the course on experimental physics given by Helmholtz and also lectures on the theory of electricity and magnetism given by Kirchhoff who had not yet, however, given his adherence to the views of Faraday and Maxwell, with which Pupin himself was now in full accord

At this time he had become interested in the new science of physical chemistry, and was cognizant of the work of J Willard Gibbs, which he brought to the attention of Helmholtz He received his Ph D degree from the University of Berlin in 1889, submitting a theoretical dissertation dealing with the subjects of osmotic pressures and free energy

In the fall of the year 1889 he began his long teaching career at Columbia University with the title of "assistant teacher of mathematical physics in electrical engineering" In 1892 he was made adjunct professor of mechanics, and in 1901 was advanced to a full professorship, with the title of professor of electro mechanics When in 1905 the departments of mechanics and physics were united, he became a member of the department of physics, with which he re-

mained in active service until 1929, when he was made professor of electro mechanics in residence

His own predilections were for research rather than teaching The dominant and magnetic personality with which he was endowed was a great asset in his teaching, which was characterized by a remarkable skill in bringing out the physical significance of mathematical formulae

In 1889, when he joined the newly created department of electrical engineering at Columbia, Pupin and his friend, Francis B Crocker, constituted the teaching personnel of the department The basic theoretical courses were given by Pupin in morning lectures, and he was also required to assist in the laboratory instruction in the afternoons Notwithstanding this heavy teaching load, he found time in the evenings to carry on with experimental research

His earliest work was concerned with the phenomena associated with the discharge of electricity through gases, and his experimental investigations in this field led to results which had an important bearing on the electromagnetic theory of the solar corona

He next occupied himself with the experimental investigation of the peculiarities exhibited by wave forms of alternating currents to which Rowland of Johns Hopkins had called attention His familiarity with the methods of Helmholtz in detecting the harmonics in vowel sounds enabled him to develop corresponding methods for the analysis of alternating current wave forms This he accomplished through the use in electrical circuits of adjustable induction coils and condensers He was thus led to the discovery of the methods of tuning which are essential in the art of radio broadcasting and communication The results of this important investigation were published in the Transactions of the American Institute of Electrical Engineers for 1894

In December, 1895, Roentgen announced his epoch making discovery of x rays Two weeks later, on January 2 1896, Pupin obtained the first x ray photograph made in America With the aid of a fluorescent screen, furnished by his good friend, Thomas A Edison, superimposed upon a photographic plate, he was enabled to obtain an excellent x ray picture with an exposure of but a few seconds

In a communication to the New York Academy of Sciences on April 6, 1896, he announced the discovery of secondary x ray radiation and is now generally accorded priority for this discovery

On April 15, 1896, Professor Pupin was stricken with pneumonia, and for several days was critically ill The necessary months for convalescence from this dread disease he spent in the beautiful town of Norfolk, Connecticut, in the Berkshire Hills, to which he became greatly attached Several years later he acquired possession of a farm near the town, and using stones from the fields, he built his picturesque summer home, to which he was accustomed to go whenever possible, not only for rest, but also for the opportunity to work free from the distractions of city life

Upon recovery from his illness he returned to the consideration of a problem which had occurred to him on a summer vacation journey through Switzerland in 1894 While in Cambridge ten years previously he had read Lagrange's paper 'Recherches sur la Nature et la Propagation du Son' in which the solution was given of the problem of a vibrating string fixed at both ends and loaded at equal intervals with equal masses He now proposed to attack a new problem, obtained by generalizing the conditions imposed by Lagrange through assuming the string itself to have weight and the medium surrounding the string to exert a dissipative reaction to its motion Not realizing at the time the tremendous practical importance of the problem, if it could be solved, he nevertheless attacked it with great vigor and eventually found its solution

The solution of this problem furnished the solution of a precisely analogous problem relating to the propagation of electromagnetic signals over a telephone line periodically loaded with inductance, and with distributed capacity Professor Pupin's solution of this analogous problem consisted essentially in showing that the malevolent influence of the capacity and resistance of the line in causing distortion and attenuation of signals could be nullified through the introduction of inductance coils at specified intervals along the line It led to an invention which was of the first order of importance in the telephone art For it enables telephone engineers to design their lines so as to avoid undue distortion and attenuation of signals In fact, it makes possible long distance telephony by overhead lines or by undersea cables and the replacement of overhead lines when desirable by underground cables, as for example, in cities and large towns In Germany telephone lines equipped with the Pupin inductance coils are called 'pupinizierte linien,' in France 'les lignes pupinizé

In order to obtain an experimental confirmation of the mathematical theory of his invention which would convince practical engineers of its utility he was forced to construct an 'artificial telephone line in his own laboratory The mathematical theory of his artificial line was communicated to the American Institute of Electrical Engineers in March, 1899

The American patent rights to Professor Pupin's telephone inventions were acquired by the American Telephone and Telegraph Company on terms not fully commensurate with the value of the invention

but highly satisfactory to him and which enabled him later to foster many philanthropic enterprises in which he was deeply interested

Not long afterwards he disposed of the patent rights relating to his wireless inventions to the Marconi Company of America

For a number of years following the first announcement of his telephone invention he was absorbed in the mathematical consideration of problems connected with the theory of telephonic communication, and in laboratory research connected with the improvement of the toroidal inductance coils which are used on loaded telephone lines He was thus diverted from active participation in the epoch making developments which were meanwhile being made in physics during the first decade of the present century

In 1909 he began to take an active interest in Serbian activities in the United States and became president of the society established in the interests of Serbian immigrants serving in this capacity until 1926

At the outbreak of the Balkan War in 1912 he was made honorary consul of Serbia in New York He started at this time at his own expense a Serbian daily newspaper, mainly for the purpose of keeping Serbian immigrants informed as to the war movements in the Balkans He also organized a Serbian sisterhood whose members were encouraged to collect contributions in aid of the Serbian Red Cross, and, in the interests of the Serbian National Defense League to inspire volunteers for war service In 1914 this work was extended throughout the United States, and highly satisfactory results were achieved

When the United States entered the war in 1917 Professor Pupin organized a Columbia University group of scientists for the purpose of developing methods for the detection of submarines He himself, notwithstanding his active duties as a member of the Committee of Aeronautics of the National Research Council devoted much time and effort in the laboratory to the development of highly sensitive receiving devices for high frequency sound waves in water

In 1919 he organized in New York City a Slavonic Immigrant Bank through which were reported daily in Slavic newspapers throughout the United States the rates of exchange for the currencies of the Balkan states, thus protecting immigrants from the predatory activities of unscrupulous money changers In 1920 he founded the Serbo American Bank in Belgrade

At the request of Premier Pashitch, Professor Pupin served as a representative of Serbia at the Paris Peace Conference in April, 1919 Here, in collaboration with his colleague Professor Douglas Johnson, of Columbia University, he was able to advance cogent arguments which resulted in extending materially the proposed boundaries of the newly created Kingdom of the Serbs, Croats and Slovenes—now known as Yugoslavia

In 1922, at the age of sixty four, he decided to write the story of his eventful life In 1923 his autobiography, 'From Immigrant to Inventor," was published Here he unfolds the narrative of his life in a manner which holds the interest of the reader from beginning to end, and in a literary style which is remarkable for its naivete and poetic imagery The appeal of this book to the general public far exceeded the expectations of the author It has been translated into several foreign languages, and letters of appreciation from all over the world gave the author the comforting assurance that the time and labor which he had bestowed upon its preparation were not in vain On account of a persistent demand an abridged edition of this book was prepared, suitable for use in the public schools

In 1927 his second popular book was published under the title The New Reformation,' with the sub title "From Physical to Spiritual Realities' The book consists of a series of seven popular disquisitions on science or narratives, as the author designates them, written with a purpose in view which can be inferred from the concluding words of the author's prologue—'It is hoped that by strengthening our understanding of the physical realities the narratives will reform our mental attitude and make it better prepared for the recognition of the truth that physical and spiritual realities are the fruit of the same tree of knowledge, which was nurtured by the soil of human experience ' In this book he has revealed the simple and rational philosophy of life to which he adhered and the spiritual sentiments which were a part of his religious faith

But brief mention can be made of the many philanthropic enterprises which he fostered Among these was a foundation for the Royal Serbian Academy in Belgrade in memory of his mother, one for the education in agriculture of young Serbs of Voyvodina, one for the restoration of old Serbian monasteries, and one for the establishment of a community house in his native town of Idvor

In recognition of his scientific and literary achievements Professor Pupin was honored by the bestowal upon him of numerous honorary degrees by universities in America and Europe, he was also the recipient of many honorary medals, and in 1925 he was elected president of the American Institute of Electrical Engineers and also president of the American Association for the Advancement of Science

In the latter years of his life Professor Pupin was

afflicted with a paralysis which deprived him almost entirely of the use of his legs This infirmity he bore with cheerful fortitude, and despite it continued his intellectual activities until stricken with the illness which resulted in his death on the twelfth day of March, 1935

In his memory and honor the trustees of Columbia University at their first meeting subsequent to the death of Professor Pupin voted to name the recently-erected physics building the 'Pupin Physics Laboratories"

A P WILLS

COLUMBIA UNIVERSITY

SCIENTIFIC EVENTS

ANNUAL MEETING OF THE TRUSTEES OF SCIENCE SERVICE

AT the annual meeting of Science Service, held in Washington on April 25, three new trustees were elected as follows Dr Harlow Shapley, director of the Harvard College Observatory, representing the National Academy of Sciences, Dr Henry B Ward, permanent secretary of the American Association for the Advancement of Science, representing that organization, Dr Ludvig Hektoen, director of the John McCormick Institute for Infectious Diseases, representing the National Research Council

Trustees reelected were Dr R A Millikan, of the California Institute of Technology, representing the National Academy of Sciences, R P Scripps, of the Scripps Howard Newspapers, representing the E W Scripps Estate, and Marlen Pew, editor of *Editor and Publisher* representing the journalistic profession

Dr J McKeen Cattell, editor of SCIENCE, was re elected *president* Other officers reelected were Dr W H Howell, of the Johns Hopkins University, *vice president* and *chairman of the executive committee* H L Smithton, of the Scripps Howard Newspapers, *treasurer*, and Watson Davis, director of Science Service, *secretary* Dr C G Abbot, secretary of the Smithsonian Institution, and Mr Pew were reelected members of the executive committee

Dr Vernon Kellogg, secretary emeritus of the National Research Council, who retired as a trustee, was elected honorary vice president in appreciation of his long service in the office of vice president Dr William E Ritter, of the University of California, is honorary president

The following resolution was adopted upon the death of Dr David White, of the U S Geological Survey, who at the time of his death was a trustee of the service

RESOLVED, That the Board of Trustees of Science Service desire to express their sincere feeling of sorrow and personal loss in the death of Dr David White His long and valuable services as a trustee, as a member of the Executive Committee and as chairman of the Executive Committee are recognized and deeply appreciated by his fellow members as constituting an important factor in the successful initiation and development of the work of Science Service It is ordered this resolution be entered upon the minutes of the meeting of April 25, 1935, and that a copy be sent to Mrs White

Annual reports of Science Service for its fourteenth full year of operation, ended on March 31, 1935, showed that news and interpretations of scientific progress are furnished to over 6,000 000 readers through newspapers utilizing news and feature reports, issued by telegraph and mail daily, weekly and monthly The weekly magazine, *Science News Letter*, gained in distribution, now having over 16,000 circulation

Various books and magazine articles written and edited by members of the staff were produced during the year, notably the book entitled "The Advance of Science" Two radio talks each week were arranged over nationwide networks of stations

Progress was made toward an extension of the work of the service in the British Empire and arrangements for the exchange of news with the Tass Agency of the U S S R were made

Research aid activities consisting of the collection of earthquake information, the distribution of cosmic data, and the investigation of archeological and anthropological discoveries were continued

The cost of operation during the year was slightly over $110,000 The endowment provided by the late E W Scripps yields $30,000 a year and the balance was more than covered by earnings

ANNUAL MEETING OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences held in Boston on May 8, Dr Roscoe Pound, dean of the Harvard Law School, was lected president He succeeds Dr George H Parker, professor of zoology at Harvard University The following were reelected vice presidents James Flack Norris, Walter Bradford Cannon, Edwin Francis Gay and Arthur Stanley Pease Joshua Whatmough succeeds Robert P Bigelow as editor Councillors elected for four years are Dugald C Jackson, Ralph H. Wetmore, Arthur N Holcombe and Kenneth J. Conant

The following new members were elected in the scientific classes

CLASS I—MATHEMATICAL AND PHYSICAL SCIENCES

Section 1, Mathematics and Astronomy Gilbert Ames Bliss, Chicago

Section 2, Physics Charles Elwood Mendenhall, Madison, Wis, Floyd Karker Richtmyer Ithaca, N Y, Robert Jemison Van de Graaff, Cambridge, Mass, Bertram Eugene Warren, Cambridge, Mass

Section 3, Chemistry Louis Harris, Cambridge, Mass, Nicholas Athensius Milas, Cambridge, Mass

CLASS II—NATURAL AND PHYSIOLOGICAL SCIENCES

Section 1, Geology, Mineralogy and Physics of the Globe Oliver Linnard Fassig, San Juan, Porto Rico, Warren Judson Mead, Cambridge, Mass, Derwent Stainthorpe Whittlesey Cambridge, Mass

Section 2, Botany Bernard Ogilvie Dodge, New York, N Y Sir William Wright Smith, Edinburgh (*Foreign Honorary Member*)

Section 3, Zoology and Physiology Charles Henry Blake, Cambridge Mass John Franklin Daniel, Berkeley, Calif Karl Friedrich Meyer, Berkeley, Calif

Section 4, Medicine and Surgery Tracy Jackson Putnam, Boston Mass

RETIREMENT OF THE SECRETARY OF THE ZOOLOGICAL SOCIETY OF LONDON

SIR PETER CHALMERS MITCHELL retired on April 29 from his post as secretary of the Zoological Society of London, after holding that office for thirty two years

At the society's annual meeting in the afternoon warm tributes were paid by the Duke of Bedford, president of the society, and other speakers to the great services which Sir Peter has rendered to the society, to zoology and to countless visitors to the Zoo in Regent's Park and its Whipsnade branch As a memorial of these services a portrait of the retiring secretary, painted by William Nicholson, was presented to the society as a joint gift from more than 1,250 members In the background of the painting is a map of the Whipsnade estate The presentation was made by Sir Henry Mahon and Professor John Stanley Gardiner

President G Elliot Smith, of University College, London, writes to the London *Times* in part as follows

To day Sir Peter Chalmers Mitchell retires from his post as Secretary of the Zoological Society of London, and that society loses the ablest and most accomplished of all those who have been the chief architects of its destiny In his thirty two years of service at the Zoo he introduced an order of excellence and efficiency to be found nowhere else in this or any other country He transformed what had become little more than an "old menagerie"—and not a very prosperous one—into a place of really enthralling experience He made himself, if anonymously, the friend of every child, and at the Zoo youth and age could meet and, hand in hand, enjoy themselves Almost single-handed he fought the battle for light and air and freedom for the animals entrusted to his care He recognized, too, how important so great a collection of living creatures could become as a means of studying comparative pathology His resources were placed at the disposal of workers in this field, and indeed in all other allied fields of research, so that he gathered round him a company of workers which included the most eminent among biologists, biochemists, dieticians and students of physiotherapy and tropical medicine

In his address at the annual meeting the Duke of Bedford called attention to the fact that in 1902 there were six pairs of entrance turnstiles and about 69,500 visitors, in 1934 there were 17 pairs of turnstiles and 1,690,000 visitors Before the recent wave of depression, for four years in succession they had each year more than 2,000,000 visitors

The new secretary of the society is Professor Julian S Huxley, a grandson of Thomas H Huxley

AWARD OF THE DANIEL GUGGENHEIM MEDAL FOR AERONAUTIC ACHIEVEMENT TO WILLIAM FREDERICK DURAND

DR WILLIAM FREDERICK DURAND was awarded on May 3 the Daniel Guggenheim Medal for 1935, "for notable achievement as pioneer in laboratory research and theory of aeronautics, distinguished contributions to the theory and development of aircraft propellers"

This is the seventh award of the medal It was made by a board having eight members in the United States of America and seven foreign members All fifteen members are men of high standing in engineering and scientific activities of aeronautics The foreign representatives are for Canada, England, France, Germany, Holland, Italy and Japan

Professor Durand, because of his extensive travels and periods of residence in Europe, is well known internationally for his experimental research on aeronautic propellers and other features of aircraft His publications have been numerous, and he is now producing a six volume work on "Aerodynamic Theory," which is being published by Julius Springer, of Berlin This encyclopedia contains contributions from numerous European and American authorities

Dr Durand was one of the first to engage in scientific research in aeronautics on his own initiative He constructed at Stanford University a wind tunnel and conducted a long series of investigations on propellers. He has served on many committees and commissions. His services to the National Advisory Committee for Aeronautics and to the Daniel Guggenheim Fund for the Promotion of Aeronautics were most valuable.

During the war he was technical attaché to the American Embassy in Paris In March, 1935, he was appointed chairman of a committee to advise the Navy Department on design and construction of airships with respect to general stability

He is a life member and gold medalist of the American Society of Naval Engineers He is a fellow of the Royal Aeronautic Society, a past president of The American Society of Mechanical Engineers and a member of the National Academy of Sciences, the American Physical Society, the Society of Naval Architects and Marine Engineers and Société Technique Maritime

Dr Durand was graduated from the United States Naval Academy in 1880, obtained the degree of doctor of philosophy from Lafayette College in 1888 and received an honorary doctorate of laws from the University of California in 1927 He is now professor emeritus of mechanical engineering at Stanford University

The Daniel Guggenheim Medal was established in 1928 and placed under the sponsorship of The American Society of Mechanical Engineers and the Society of Automotive Engineers jointly, each of which appoints four members of the Board of Award The president of the 1934–35 board, which awarded the medal to Dr Durand, was Major E E Aldrin, of The Standard Oil Company of New Jersey, and Arthur E Nutt, of the Wright Aeronautical Corporation was vice-president

Previous recipients of the medal were Orville Wright, of the United States Ludwig Prandtl, of Germany, Frederick William Lanchester, of England, Juan de la Cierva, of Spain, Jerome Clarke Hunsaker and William F Boeing of the United States

ALFRED D FLINN
Secretary

RECENT DEATHS

DR EDWIN BRANT FROST, director emeritus of Yerkes Observatory and professor emeritus of astrophysics at the University of Chicago died on May 14 in his sixty ninth year

DR. MARSHALL HOWARD SAVILLE professor of American archeology at Columbia University died on May 7 at the age of sixty seven years

DR LUCIAN W CHANEY formerly professor of biology at Carleton College and from 1908 until his retirement in 1930 statistical expert of the U S Department of Labor died on May 6 at the age of eighty seven years

CHARLES THOMAS LUPTON, consulting geologist at Denver Colo, died suddenly on May 8 at the age of fifty-seven years

DR WILHELM KOLLE, privy councillor and director of the State Institute for Experimental Therapy and of the Chemico Therapy Research Institute, at Frankfort, died on May 10 at the age of sixty six years Dr Kolle succeeded Paul Ehrlich at the Franklin Institute in 1915

SCIENTIFIC NOTES AND NEWS

DR. FRANK B MALLORY, until his retirement in 1932 professor of pathology at the Harvard Medical School editor of *The American Journal of Pathology*, was awarded the George M Kober Medal by the Association of American Physicians at the recent Atlantic City meeting The presentation was made by Dr James Ewing, of the Cornell University Medical College

THE Mendel Medal, awarded annually by Villanova College for research by a scientific man who is a Roman Catholic, was presented on May 7 to Dr Francis Owen Rice, professor of chemistry at the Johns Hopkins University The Very Rev Edward V Stanford, president of the college, made the presentation at a faculty dinner with an attendance of about two hundred

THE laboratory award of $5,000 offered by Mead, Johnson and Company has been divided, one half being given to Dr S B Wolbach, of Harvard University, for his "basic work on the pathology of avitaminosis A and his investigations on the regeneration of epithelial tissue impaired by vitamin A deficiency, and the relationship of vitamin A to the integrity of the teeth", and one half to Dr Karl F Mason of Vanderbilt University, for distinguishing exactly between the pathology of avitaminosis A and avitaminosis E, and for his contribution to the quantitative relationship of vitamin A deficiency to the keratinization of germinal epithelia The award of $15 000 to be given to the investigator or group of investigators producing the most conclusive research on the vitamin A requirements of human beings" has been postponed until December 31, 1936

Nature reports that the August Forel Foundation of the German Academy of Sciences at Halle, which is to award a prize every two years for researches in the subjects in which Forel was specially interested (eugenics, the alcohol problem, study of ants and the central nervous system), has made its first award to Dr Graf, who is head of the department of industrial physiology at the Kaiser Wilhelm Institute of Dortmund

ST JOHN'S COLLEGE Annapolis, will confer the honorary degree of doctor of letters on Dr Raymond Pearl, professor of biology in the School of Hygiene and Public Health of the Johns Hopkins University at its commencement exercises on June 5

DR EUGENE WILLIS GUDGER of the American Museum of Natural History has been elected to life membership in the North Carolina Academy of Science "in recognition of his many years of active service with a spirit of loyalty to the academy and the state"

THE order of the Crown of Italy was formally presented on May 7 to President James Rowland Angell, of Yale University by Augusto Rosso the Italian ambassador The order was conferred upon Dr Angell with the rank of grand officer, the highest degree, for his part in improving cultural relations between Yale and the Italian universities

DR E B RENAUD professor of anthropology at the University of Denver and French consular agent for Colorado Wyoming and Utah, has been awarded the Cross of Knight of the French Legion of Honor for his scientific work in anthropology and archeology

DR R T WOODYATT professor of medicine in Rush Medical College of the University of Chicago, was elected president of the Association of American Physicians at the recent meeting in Atlantic City He succeeds Dr Henry A Christian Hersey professor of the theory and practice of physic at the Harvard Medical School

DR JOHN LOVETT MORSE professor of pediatrics, emeritus at the Harvard Medical School was given a dinner at the Country Club in Brookline on April 22 in honor of his seventieth birthday, which occurred on April 21

DR EDWARD WESTON, chairman of the board of the Weston Electric Instrument Company, celebrated his eighty fifth birthday on May 9

THE University Court of St Andrews has recorded a minute on the occasion of the jubilee of the appointment of Professor D Arcy W Thompson to the university As reported in *Nature*, 'Tribute is paid to his outstanding worth and ability, not only in his own department of natural history but also in other departments of literary and scientific knowledge His election to the presidency of the Classical Association testified to his knowledge of and interest in the ancient languages and literatures of Greece and Rome, his election as an honorary member and as president of the Edinburgh Mathematical Society in recognition of his pioneer work in the application of mathematical methods to biological studies was a guarantee of mathematical ability of no mean order, and his work as adviser to the Fishery Board for Scotland, and as a delegate to the Bering Sea Fisheries Conference and to the North Sea Conference indicated his international reputation as a scientific administrator"

SIX members of the faculties of the University of Minnesota will reach the retirement age this year Among these are Dean William R Appleby, head of the School of Mines and Metallurgy since it was established Professor Andrew Boss, vice director of the Agricultural Experiment Station at University Farm and Professor Peter Christianson, metallurgy

AT Harvard University Dr Frederick F Russell, general director of the International Health Board of the Rockefeller Foundation since 1923, has been appointed lecturer on preventive medicine and hygiene and epidemiology at the Medical School Dr Lars V Ahlfors now adjunct professor of mathematics at the University of Helsingfors, has been appointed lecturer on mathematics and tutor in the division of mathematics

AT the University of Belfast, Dr Henry Barcroft, lecturer in physiology at University College, London, has been appointed Dunville professor of physiology, and Dr D C Harrison, lecturer in the University of Sheffield has been appointed to the J C White professorship of biochemistry

DR HOWARD ADDISON ROBINSON, now a teaching fellow in physics at the Massachusetts Institute of Technology, has been appointed to the Irving Langmuir Fellowship of the American Scandinavian Foundation He expects to continue his work on spectroscopy in Sweden

THE Electrochemical Society has awarded the seventh Weston Fellowship of $1,000 founded by Dr Edward Weston, to Myron A Coler of New York He will carry out his work on electrophoresis at Columbia University

THE annual meeting of the Board of National Research Fellowships in the Biological Sciences, for the award of 1935-36 appointments, was held in Washington D C on March 30 and 31, 1935 No reappointments were made at this meeting Twenty three new appointments were awarded as follows For domestic study *zoology* Henry Alver Bess, Donald Randolph Charles Frederick Crescitelli, Frances Sue Dorris, Graham Phillips DuShane, Allan Charles Scott and Benjamin Robert Speicher, *anthropology*, Cora Du Bois and Chas Frederick Voegelin, *psychology*, Glen Finch, Ward Campbell Halstead and Edward H Kemp, *botany*, Walter S Flory, Jr, Winslow R Hatch and Donald Philip Rogers, *agriculture*, Wm B Graham, Jr, and Harland G Wood For foreign study *forestry*, Wm Clark Bramble and Jas W Johnston, Jr *anthropology*, Helen L Dawson,

agriculture, Lyman Arnold Dean, *zoology*, Richard Marshall Eakin, *botany*, Harold Norman Moldenke

THE Committee on Scientific Research of the American Medical Association has made a further grant of $500 to Dr L A Emge, clinical professor at the Stanford University School of Medicine, for his investigation of the effect of castration on benign and malignant tumor growth This is the fourth grant that the committee has made for this study of transplantable tumors Dr G E Burget, professor of physiology at the University of Oregon Medical School, Portland, has received a grant to aid in studies on the physiology of the esophagus and cardia, and Dr Dean A Collins, instructor in physiology at the University of Minnesota, a grant for the purpose of aiding in some work on hypertension following partial ligation of the renal arteries

DR HANS ZINSSER exchange professor from Harvard University to the University of Paris, is continuing his studies on typhus at the Pasteur Institute He is working in a laboratory placed at his disposal by Professor Nicolle and is also giving lectures on bacteriology in the medical school

DR. KARL T COMPTON, president of the Massachusetts Institute of Technology and president of the American Association for the Advancement of Science, gave on May 10 a popular lecture on 'Some New Developments and Applications of High Voltage Electricity' before the Lancaster Branch of the association

DR ROBERT CUSHMAN MURPHY curator of oceanic birds at the American Museum of Natural History lectured on 'The Behavior of Penguins' at the annual initiation dinner of the Columbia Chapter of Sigma Xi on May 6

DR WALTER L BIERRING, president of the American Medical Association spoke on "The Historical Sequence of Medical Events" on May 10, before the Marquette University School of Medicine After the lecture, Dr Bierring was the honor guest at a dinner given by the advisory faculty consisting of the heads of departments and divisions

AT the twelfth annual meeting of the West Virginia Academy of Science held at Davis and Elkins College on May 3 and 4, Dr W W Cort, of the School of Hygiene and Public Health of the Johns Hopkins University, was the principal speaker

AT the meeting of the British Institution of Electrical Engineers, on May 2, at which the presentation was made to Dr F B Jewett of the Faraday Medal, Sir William Bragg delivered the twenty sixth Kelvin lecture His subject was 'The Molecular Structure of Metals'"

THE third prize contest for research on the genetics of mental disorders has been instituted by the Eugenics Research Association The sum of $5,000 is available, budgeted as follows First prize $3 000 second prize $1 000 and $1,000 for publication of the winning essays as monographs of the association for small honoraria for the judges and for other expenses connected with the contest

THE department of geology of Northwestern University is in receipt of a gift of $1 000 from the Penrose fund of the Geological Society of America for the purpose of completing a research project to determine the origin of South Park The study was started two years ago by Drs J T Stark, C H Behre Jr W E Powers and A L Howland in conjunction with Dr J Harlan Johnson, of the Colorado School of Mines, and Dr Donald B Gould of Cornell College Mt Vernon, Iowa The work hitherto has been financed in part by research grants given by Northwestern University The expedition will leave on June 15 for Colorado, where two months will be spent in the field gathering additional data

ACCORDING to *The Museum News* a new 30 acre botanic garden has been opened recently in Trinity Park, Fort Worth, Texas The garden was built by relief labor and largely financed through the CWA, the park department of the city contributing $7,000 for purchase of materials The design, which combines formal and informal elements is by S Herbert Hare of Kansas City Fort Worth Botanic Garden is under control of the Board of Park Commissioners of the city R C Morrison city forester, had charge of the development of the garden and is supervising its maintenance The park department has allotted $9 000 this year for maintenance of the garden

IT is reported by special cable to *The New York Times* from Antofagasta that members of the British scientific expedition have arrived there and will establish a base 14,000 feet above sea level on Mount Aconquilcha in the Chilean Andes in order to study the effects of the altitude Complete equipment has been brought by the expedition, which includes Dr Forbes Heys, of Harvard University, and Dr Bryan Mathews, of the University of Cambridge The constant failures to climb Mount Everest and other peaks have decided the members of the expedition to make a complete study of conditions of life at high altitudes

A 50,000 ACRE tract in Hyde County, N C, that is being restored to the swans, geese and ducks as part of the waterfowl restoration of the Bureau of Biological Survey, has been reserved and set apart by

executive order as the Lake Mattamuskeet Wildlife Refuge. Lake Mattamuskeet originally was a body of shallow water about 12 miles long and 7 miles wide. Several years ago an attempt was made to drain it, but the plan proved impractical. The drainage operations deprived waterfowl of one of the best resting and feeding areas on the Atlantic Coast. Now, with funds from the Federal Emergency Relief Administration for the retirement of submarginal lands, the government is purchasing the lake bed and permitting the lake to restore itself naturally. Swans, geese and many species of ducks—principally pintails, widgeons, mallards and black ducks—are found in numbers on the water areas available. Even the drainage of the lake bed did not deter some birds from returning season after season to rest on the surface of the canals and low places, and it is expected that the restored lake will again attract large concentrations of swans and other waterfowl.

President Roosevelt has requested the State Department to approach the Canadian government on joint action to preserve Niagara Falls in its present beauty. His move was occasioned by three landslides at the falls which tore down tons of rock and made indentations in the semicircle of cascading water. The last slide was in December. The President has asked the State Department to propose international construction or remedial works to preserve the falls through the special International Niagara Board. He appended the proviso that nothing in any such agreement should affect the permanent allocation of water rights or further divert Niagara water to the use of private power companies. In 1929 a treaty looking to protection of the falls was passed by the Canadian Legislature, but was held up in the U. S. Senate when a private power development clause was criticized.

Duke University announces the establishment of graduate scholarships and fellowships in forestry, carrying stipends which range from $250 to $650. Preference will be given to men who have studied French and German and who have already obtained technical or professional training as represented by a degree from a school of forestry of good standing. Major work, which may be used toward an advanced degree, should be in one of the following fields of concentration: forest-tree physiology, silvics, forest soils, silviculture or forest management. The work will be closely coordinated with research being conducted in the Duke Forest and in the university laboratories and greenhouses by the forestry, botany and zoology staffs. Full information may be obtained from the Director, Duke Forest, Duke Station, Durham, N. C.

A correspondent of the London *Times* writes as follows: "For years there has been a division of opinion between the British Empire, the United States, Scandinavia and Holland on the one side, and most of the Latin nations on the other, as to the functions of the International Institute of Agriculture in the field of agricultural science. Countries such as the United States or those of the British Empire possess national or imperial means for the dissemination of scientific information, and spend for this purpose more than the International Institute in Rome can afford. At a meeting of the permanent committee of the institute on March 22 in Rome it was decided, on the advice of a panel of scientists, presided over by Sir John Russell, director of the Rothamsted Experimental Station, that the institute shall in future retire from the more purely scientific side of the information service and concentrate upon the practical and international aspects of such work."

We learn from the London *Times* that the governor of Bengal has inaugurated a National Institute of the Sciences of India, of which the object is to promote scientific knowledge in India. The institute will act through national committees, and will serve as a national research council for the undertaking of work of national and international importance required by the public and the government. It will be a coordination body, not competing with existing academies, but bringing them into cooperation. The headquarters will be in Calcutta, and the membership will be 125 foundation fellows, with the addition of 10 elected annually. Dr. L. L. Fermor, director of the Geological Survey of India, is the first president.

DISCUSSION

FOREIGN GEOGRAPHIC NAMES

Post-war changes in foreign geographic names are disconcerting to teachers of geography, to students and to the general public. American publications, whether written by geographers or others, show no consistency in the adoption of "new" names. The accuracy of publications using foreign geographic names is challenged because of their failure to adopt new forms or because new forms are used in some instances and not in others. On occasion such changes may be cited to discount a writer unfairly—the situation is becoming increasingly critical and therefore, it seems, deserves aggressive action by authoritative bodies.

Students are confronted to-day with a variety of

text-books, so-called work-books, exercise sheets of different sorts, and political, economic and other kinds of atlases, among which there is no accord with respect to the form of foreign geographic names One large commercial atlas shows no old names Naturally students are bewildered and ask which one of these is correct They may sit in courses offered by several different instructors, among whom there is no agreement as to the proper form, thus giving rise to further confusion

The public press has shown an inclination to adopt some of the new names even without mention of the old Peiping, Manchukuo, Oslo, Istanbul, Marseille and a few others are already in common use, but the same editors seem reluctant to use Firenze, Venezia, Praha Warszava, S Gravenhage or Manaus Historians, too, hesitate to adopt the "new" names Like others they fear their readers may not recognize these names and hence may lose the purport of their reference, and they do not wish to clutter up the page with dual names, one within a parenthesis and one outside

We enclose the word *new* in quotation marks because these names are new only to the uninitiated Rather are they mostly old names resurrected in consequence of the stimulated post war nationalism or names which have always been in use by the natives of the respective countries who now wish to have those names used internationally in the place of translations or even transliterations heretofore given the preference Exceptions to this statement include names in the U S S R which are new not only to the outside world but to the nationals themselves

To make matters even more perplexing, we are confronted with differences in usage of geographic names within some of the foreign countries where minorities wield considerable influence In Finland a commission was set up to decide upon the official forms Although both the Swedish and Finnish languages have official recognition in the courts and although in a number of centers where the Swedish speaking people are in the majority the Swedish name is cited as official, most of the official geographic names applied to natural features, as well as political units, have been designated by Finnish forms Nevertheless, the Swedish Finns are reluctant to adopt these latter forms and persist in the use of the names in vogue when Finland was under Swedish rule

A somewhat similar bi lingual struggle has manifested itself in Czechoslovakia, although much less emphatically than in Finland, owing to the fact that German is not an *official* alternative language The German element in the population gives its preference to German geographic forms which many countries, including our own, have used for years and which are still widely used in the face of Czech desires that they be abandoned

No doubt one of the first reactions of the reader to the comments thus far offered brings the suggestion that we are already provided with boards who have passed upon proper forms The work of the U S Geographic Board and of the Permanent Committee on Geographical Names for British Official Use has unquestionably been well done, but their deeds are relatively little known among the mass of people, including great numbers of teachers It is one thing to make these decisions, but quite another to disseminate them

The Committee on Geographic Names recently organized within the U S Department of the Interior, might well join hands with the British Committee for the purpose of securing repeated publicity of their conclusions through the public press They might also enlist the assistance of all map publishers This effort, combined with an educational campaign, would establish common usage of a single form for each political or natural geographic phenomenon of the earth

By adopting a standardized method for showing both old and new names until such time as the old names may be dropped, if that seems desirable, all persons would eventually use the same names The new name might be followed by the old name in parenthesis That this method contains at least the essence of possible success may be indicated by the experience of the city of Chicago when its local government decided to change the house numbering system It was proposed that for a time the old number be carried along with the new number There was the customary opposition by the conservatives, owing to the fear that two numbers would be confusing, but the objections were swept aside and the double system came into being In the course of two or three years the old numbers vanished, the new numbers rendered effective service and the change was completed without hardship or serious heartaches Had this situation been left to its own devices and undirected, the switch over would hardly have been successfully accomplished

If we were concerned with one or two occasional changes in geographic names the matter of universal adoption would not assume serious proportions But when changes occur upon a wholesale scale resulting in confusion the public looks to the profession within whose realm such matters lie to help them out of their dilemma If the ultimate adoption of all these new forms must await the trials of "common usage," the period of uncertainty may be prolonged unduly On the other hand, if geographers can reach an accord a real service will be rendered

EUGENE VAN CLEEF

OHIO STATE UNIVERSITY

FURTHER ATTEMPTS TO GROW CHILOMONAS PARAMECIUM IN INORGANIC MEDIA

Chilomonas paramecium although one of the crypto monad flagellates has generally been considered saprozoic in nutrition and thus dependent upon organic sources of nitrogen This belief has been supported by the investigations of Pringsheim[1] and Loefer[2] Mast and Pace,[3] however, have stated that this flagellate is able to synthesize protoplasm from inorganic substances alone In view of this apparent contradiction, the earlier experiments of Loefer have been repeated, using some of the media of Mast and Pace and following their technique as well as that previously developed in our own laboratory The strain of *Chilomonas paramecium* the one used previously by Loefer, was isolated at Woods Hole in 1932 and has since been maintained in bacteria free cultures

"Solution D" of Mast and Pace and a similar solution, with NH_4NO_3 substituted for NH_4Cl were used as inorganic media in the depression slide technique of Mast and Pace and the culture tube technique of Loefer Growth was always obtained in the first transfer from a peptone stock culture, and sometimes in the succeeding second and third transfers In further transfers, however, our strain of *C paramecium* failed to grow in the inorganic media Even the addition of glycocoll, as used by Mast and Pace ("Solution B"), sometimes failed to prolong growth of the flagellates beyond the fourth transfer It would seem therefore, that our strain of *Chilomonas paramecium* is unable to synthesize protoplasm from ammonium compounds and other inorganic salts and is thus quite different in this respect from the strain used by Mast and Pace

J B LOEFER
R P HALL

NEW YORK UNIVERSITY

SHALL SMOKY CITIES GO TREELESS?

THE severe limitations imposed by city air pollution on decorative and ornamental vegetation has been brought to our attention by Mr Kenneth Soergel, landscape gardener, State Capitol Park, Harrisburg, Pa The base plantings at the Capitol building are described by him as being largely evergreens, consisting of Taxus, Juniper, Cryptomeria Pine Spruce and Rhododendron Only the Taxus is said to be doing well, all others are "low in vitality, with many dying or beyond recovery" It is added that uncontrolled railroad smoke and the city heating plant are three blocks east of the Capitol and that large hotels facing the park also have heating plants The result stated is "excess of smoke"

[1] E G Pringsheim, *Beitr allg Bot*, 2 88–137, 1921
[2] J B Loefer, *Biol Bull*, 66 1–6, 1934
[3] S O Mast and D M Pace, *Protoplasma*, 20 326–358, 1933

As a result of our own experiments in helping to protect some evergreens against damage by air pollution, we have recommended to the state gardener a process of mechanical spraying, employing soap, water and a chemically neutral detergent Cohen and Ruston, in "Smoke, a Study in Town Air," report on tests of the efficacy of actual solid deposits to lower the rate of assimilation of CO_2 by plants They found that cleaning of the leaves raised plant efficiency by about 65 per cent but still left the plant far short of the rate of assimilation it would have had in rural air

Posed, therefore, is the question If smoke remains unabated and the most widely used evergreens can not live in polluted air, can substitutes be found, and if not, are we not faced with a problem for scientists generally a problem that goes beyond the bounds of botany?

H B MELLER
L B SISSON

MELLON INSTITUTE

THE WILLIAM HERBERT CENTENNIAL

IN recognition of the lasting influence of William Herbert's "Amaryllidaceae,"[1] which appeared in 1837, the American Amaryllis Society has voted to observe the William Herbert Centennial in 1937 The society will dedicate its Year Book in that year to Herbert and his work A comprehensive biography of the divine scholar and scientist will be published together with a reprint of his stimulating essay "On Crosses and Hybrid Intermixtures in Vegetables," which apparently has been obscured because it is appended to the "Amaryllidaceae"[1] This essay is a most remarkable one, considering the date when it appeared Reference is made to only one passage to serve as an illustration

Herbert crossed each of two turnip varieties with hairy leaves and straw colored flowers on the Swede or ruta baga with smooth leaves and bright yellow flowers The first generation plants had leaves like the male parent He does not indicate the color of the flowers The greater part of the second generation individuals secured by selfing the first generation hybrids had bright yellow and a smaller part had straw colored flowers He observes that these colors were not blended nor did they modify each other He does not give information about the leaf characters in the second generation Herbert's own words as they appear on page 370 are as follows

> I impregnated in 1834 with great care the Swedish turnip (ruta baga) with pollen of the white, and another branch thereof with that of the red rooted turnip The seed was sown immediately, and the plants of both

[1] "Amaryllidaceae, preceded by an attempt to arrange the Monocotyledonous Orders, and followed by a Treatise on Cross bred Vegetables and a Supplement" London James Ridgeway and Sons 1837

crosses though late, formed pretty roots The leaves differed in appearance from those of Swedes, and did not, like them, retain the rain water on their surface In the following spring they were set for seed in two different situations where no extraneous pollen might have access The flowers of the greater part were of the bright yellow of the two male parents, a smaller portion of each lot produced a straw color blossom, like that of the Swede, but not one shewed the least disposition to an intermediate tint, and it seemed as if those two colours were incapable of blending, or modifying each other

William Herbert, a brilliant divine and scholar, carried on his plant researches as a hobby His monograph on the "Amaryllidaceae" is a landmark on the phylogeny of this group, and his extensive work in plant breeding, mostly with *Amaryllidaceae*, and other ornamentals, has placed him in the same rank as Thomas Andrew Knight, a pioneer plant breeder

HAMILTON P TRAUB

'MIRA FLORES'
ORLANDO FLORIDA

THE GANESH PRASAD PRIZE

THE great interest shown by Hindu scholars during the last few years in the history of mathematics in India is well known During nearly a century the subject had been so neglected as to give the impression that such early English writers as Colebrooke and Taylor had exhausted the subject Among the later Hindu translators of the early works the first of the outstanding Hindu scholars was Rangacarya, whose edition of Mahavir is well known There have also been a number of later scholars who have published certain expository articles upon the history of the subject and have thus awakened a new interest in various semi forgotten works of merit Several of their contributions have appeared in such publications as the *American Mathematical Monthly* and the *Scripta Mathematica*, and others are promised for the new series about to appear under the name of *Osiris*, sponsored by the History of Science Society

In view of the present activities shown by Hindu scholars it is interesting to know that the Calcutta Mathematical Society has recently announced for the subject of the competition for the 'Krishna Kumari Ganesh Prasad Prize and Medal' the following 'Lives and works of the ten Famous Hindu Mathematicians Aryabhatta, Varamihir, Bhaskara I, Lalla, Bramhagupta, Sridhar, Mahavir, Sripati, Bhaskara II, Narayana ' (Spellings of proper names as in the announcement)

In view of the excellence of various recent articles by Hindu scholars, it may be expected that the winner in the contest will offer to the English speaking world a work of outstanding importance

DAVID EUGENE SMITH

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MINUTES OF THE EXECUTIVE COMMITTEE MEETING

THE regular spring meeting of the executive committee was held in New York City on April 14, 1935, in the office of The Science Press, Grand Central Terminal, with the following members present Dr Cattell, *chairman*, Drs Caldwell, Compton, Conklin, Curtiss, Livingston, McKinley, Ward, Wilson and Woods Dr Hildebrand was excused for absence

It was reported for record that minutes of the last meeting held in Pittsburgh in December were approved by mail

The following resolutions, drawn up by the treasurer, laid before the executive committee in December and held over for further study, were brought up for final action and after amendment adopted in the following form as representing the general policy of the council

No expenditure shall be authorized or made from the permanent funds of the association in the keeping of the treasurer except in pursuance of a previous action by the council or by the executive committee under Article IV, Section 1, of the by laws

The council at the annual meeting in each year shall make general appropriations for the current fiscal year, but nothing contained herein shall prevent the council making special appropriations at any meeting

It shall be the duty of the finance committee to provide for the safe custody of all financial resources of the association and to determine all matters relating to purchase and sale of its securities It shall consider and recommend to the council from time to time such measures as in its opinion will promote the financial interests of the association

The need of a change in the present financial arrangement in payment of subsidies to affiliated academies, as previously announced at Atlantic City and Pittsburgh, was studied, and after considerable discussion it was voted that in lieu of allowances sums should be paid to affiliated academies in the form of grants for research Dr Livingston, the general secretary and the permanent secretary were appointed a committee to perfect the plan

The general secretary, Dr Caldwell, presented a report on the work thus far done in establishing local

branches and on other matters pertaining to his office On his recommendation it was voted to authorize the acceptance of the following organizations as local branches Westchester (N Y) Institute of Sciences, Phoenix (Arizona) Local Branch, Southern Florida Science Association at Miami, Southern Rhode Island Local Branch at Kingston

The executive committee looked with favor on the establishment of a branch at Mobile, Ala, subject to approval of the state academy

The executive committee voted to appropriate $750, or as much of that amount as may be needed, for clerical and traveling expenses of the general secretary's office until September 30, 1935

The executive committee approved the following outline, presented by Dr Compton, as representing general policy of the association

> Exhibits sponsored by the American Association for the Advancement of Science should be limited strictly to the following categories
>
> (1) Exhibits which illustrate scientific studies phenomena or progress
>
> (2) Exhibits of apparatus methods or materials which are useful in scientific instruction or research
>
> (3) Exhibits of publications which are of value in the dissemination or advancement of knowledge in science
>
> (4) Exhibits of such other types as may be clearly defended for their value as aids in education or research in science
>
> It shall be the duty of the Director of the Exhibition to see that exhibits are limited to those falling within the above classifications

The executive committee accepted the resignation of Dr E B McKinley as secretary of the section on medical sciences On recommendation of the section committee, Dr Vincent du Vigneaud was elected secretary of the section to succeed Dr McKinley, his term of office to continue until December, 1936

Dr Moses Gomberg was elected a member of the committee on grants to represent chemistry, succeeding Dr Roger Adams, resigned, his term of office to continue until December, 1938

Dr Herbert Osborn was appointed the association's representative on the board of trustees of *Biological Abstracts*, his term of office to continue until April, 1939

Extended statistical reports on association finances, membership, circularizations inviting new members and special publications, were discussed and approved

Dr Compton was authorized to sign the indemnity bond renewal covering the permanent secretary and the executive assistant

On recommendation of the special committee on types of membership (Drs F V Coville and A F Woods and the permanent secretary) the following by law was adopted Members who have paid annual dues for 50 years may be excused from further payments and still retain all the privileges of active membership

The permanent secretary presented an outline showing for the endowment funds of the association the exact conditions under which they were received

The general secretary, Dr Caldwell, was added to the membership of the committee on adult education

It was voted to adopt a resolution subsequently worded as follows

> The Executive Committee of the Council of the American Association for the Advancement of Science urges all members of the Association to give careful study and consideration to the report of the Commission of Inquiry on Public Service Personnel (Now available in book form published in full by Whittlesey House) A non politically administered Civil Service designed to secure for government work the best qualified workers is essential if government is to function efficiently The organization at least of the professional and scientific services on a career basis is essential to secure and hold young men and women of capacity and character They must have opportunity for advancement through service and growth to posts of distinction and honor There must, of course be adequate provision for the elimination of the unfit We recognize that in many branches of the professional and scientific service in the Government and in several of the States great progress has been made along the lines recommended by the commission In these services the quality of personnel secured and maintained is fully equal to comparable positions outside the Government service, though salaries, especially in the upper brackets, are frequently much lower The A A A S will support all sound proposals for the improvement of public scientific and professional service

Dr J B Macelwane was elected a member of the committee on grants, succeeding Dr E W Berry, resigned Dr Macelwane is to represent geology and his term is to continue until December, 1936

The permanent secretary announced that Professor F J E Woodbridge, of Columbia University, would deliver the Phi Beta Kappa address at the St Louis meeting

Dr Carl Snyder was elected a fellow of the association

The permanent secretary announced that the Section on Social and Economic Sciences elected Carl Snyder as a member of the section committee, his term of office to continue until December, 1938

The Society for Research in Child Development, subject to receipt of the formal application, was accepted as an affiliated society with one representative in the council

The American Association of Colleges of Pharmacy was accepted as an associated society

The Missouri Academy of Science was accepted as an affiliated academy with one representative in the council without any financial arrangement, in accordance with action taken in the recent affiliations of other academies

The Institute of Aeronautical Science was accepted as an affiliated society with one representative in the council

The Society for Research on Meteorites was accepted as an associated society

The American Division of the International Association for Dental Research was accepted as an affiliated society with one representative in the council

The chairman announced that on request of the special committee on research fellows the report of that committee now pending before the council had been withdrawn

The permanent secretary announced the appointment by the president of Professor A P Wills as the representative of the association on the Sectional Committee on Electric and Magnetic Magnitudes and Units of the American Standards Association

The permanent secretary presented a printed copy of the address by Dr Mark H Liddell on "A New Theory of Sound," read at the Pittsburgh meeting This is the final report of a research made possible by a grant from the association several years ago

The permanent secretary announced that railroad rates for the Minneapolis meeting have been limited by the traffic association to bona fide members (and their families) of the association and its associated societies

The committee adjourned, to meet in Minneapolis on Monday, June 24, at 9 00 A M

HENRY B WARD,
Permanent Secretary

STATE ACADEMIES

THE PENNSYLVANIA ACADEMY OF SCIENCE

THE eleventh annual meeting of the Pennsylvania Academy of Science was held on April 19 and 20 The academy was the guest of Dickinson College, Carlisle, Pennsylvania Titles of 59 papers and demonstrations were included on the program and, except for the brief business meeting, these filled the session The annual dinner on Friday evening was followed by the presidential address, "The First Decade of the Pennsylvania Academy of Science," by Professor S H Derickson Dr William W Cort, of the Johns Hopkins University, guest speaker of the evening, addressed the society on "Biological Studies on Human Parasites" A total attendance of 103 members and guests registered, besides 41 members of the Junior Academy A representation of 35 physicists from the state met simultaneously, partly as a sectional group and partly in joint conference with the main body of the academy The following officers were elected for 1935–1936

President Professor Edgar T Wherry (botany), University of Pennsylvania

Vice President Dr T D Cope (physics), University of Pennsylvania

Secretary Dr T L Guyton (entomology), Pennsylvania Department of Agriculture

Assistant Secretary Dr V Earl Light (biology), Lebanon Valley College

Treasurer Professor H W Thurston, Jr (botany), Pennsylvania State College

Editor R W Stone (geology), Pennsylvania Topographic and Geologic Survey

Press Editor Dr Bradford Willard (geology), Pennsylvania Topographic and Geologic Survey

The 1935 summer meeting and field trip is to be held in the Poconos in August The time and place of the 1936 annual meeting are to be announced subsequently

BRADFORD WILLARD,
Press Secretary

THE ALABAMA ACADEMY OF SCIENCE

THE twelfth annual meeting of the Alabama Academy of Science was held at State Teachers College, Florence, Alabama, on Friday and Saturday, April 12 and 13, 1935

There were ninety nine members and guests registered, fifty two papers presented in four sections and three demonstrations given At the banquet on Friday evening Dr Russell S Poor, Birmingham Southern College, gave the presidential address on "The South's Position in the Mineral Industry" Dr George M Hall, president of the Tennessee Academy of Science, was an honored guest

Following the banquet there was a reception during which a demonstration with ultra violet light of fluorescent minerals of Alabama was given by Dr David L De Jarnette, curator of the Alabama Museum of Natural History, and his assistant, James T De Jarnette

On Saturday morning Dr Walter B Jones, state geologist, conducted a geological field trip through the Muscle Shoals district At noon an old time Southern barbecue was given on the campus of State Teachers College by President H J Willingham of the college In the afternoon an industrial trip under the direction

of Professor Floyd F Cunningham, of State Teachers College, was taken to the T V A developments Among the places of interest visited were Nitrate Plant No 2, which T V A officials very kindly explained, the finished Wilson Dam and the new Wheeler Dam now under construction

On Saturday morning the Alabama Junior Academy of Science held its third annual meeting at the same place Twelve high schools from all parts of the state were represented

The following officers were elected for the year 1935 36

President A G Overton Alabama By Products Corporation, Tarrant, *President elect* Walter B Jones state geologist, University, *Vice president* (Biology and Medical Science), C M Farmer, State Teachers College, Troy, *Vice president* (Chemistry, Physics and Mathematics), B F Clark, Birmingham Southern College, Birmingham, *Vice president* (Geology, Anthropology and Archeology), T G Andrews, University of Alabama, *Vice president* (Industry and Economics), W M Mobley Alabama By Products Corporation, Tarrant, *Editor of the Journal*, E V Jones, Birmingham Southern College, Birmingham, *Secretary* Septima Smith University of Alabama *Treasurer*, B F Clark Birmingham Southern College Birmingham, *Councillor to the A A A S* P H Yancey, Spring Hill College, Mobile

The next meeting will be held at the Alabama Polytechnic Institute, Auburn, Alabama, some time in March, 1936

P H YANCEY

THE TENNESSEE ACADEMY OF SCIENCE

THE spring meeting of the Tennessee Academy of Science for the year 1935 was held on April 26 and 27 at the Reelfoot Lake Biological Station There were three sessions on Friday and two on Saturday in the laboratory building Headquarters were at the Walnut Log Lodge, four hundred yards away Excursions were taken on Saturday afternoon on and around the lake

At the meeting on Saturday evening, Dr George M Hall, president, presiding, Dr A R Middleton, professor of biology, University of Louisville, secretary of the Kentucky Academy of Science, gave an address on "A Summer in Honduras"

Sixteen of the twenty four papers were by members of faculties of schools Two were by members of the academy residing outside of Tennessee—Dr Mary Minerva Steagall, head of the department of zoology, Southern Illinois State Normal University, Carbondale, Illinois, and Dr Emily Barry Walker, head of the science department, East Texas State Teachers College, Commerce. Schools in Tennessee represented were in East Tennessee, the University of Tennessee, Knoxville, and the State Teachers College, Johnson City, in Middle Tennessee, Vanderbilt University and George Peabody College, Nashville, in West Tennessee, Southwestern and State Teachers College, Memphis, Lambeth College, Jackson, Freed Hardeman College, Henderson Departments of science leading in the number of papers were biology 5, geology 4, public health 3

The academy holds two meetings each year—one at Nashville in the fall and one either in East or West Tennessee in the spring Reelfoot Lake is in the northwest corner of the state The attendance of between forty and fifty members at the meeting was consequently fully as many as expected This far away place was chosen for the meeting on account of the location there of the Biological Station, which is under the control and management of the Tennessee Academy of Science Dr Middleton, who delivered the address on Saturday evening, is a member of the council of the American Association for the Advancement of Science

The general appropriation bill passed by the House at the recent session of the Legislature carried an appropriation of $2,500 to the academy to be expended during the biennium 1935–1937 for the benefit of the station, but the Senate postponed consideration of the bill to an extra session of the Legislature in May or June thus embarrassing the academy in arranging for work at the station this summer

J T MCGILL,
Secretary Treasurer

THE MINNESOTA ACADEMY OF SCIENCE

WITH an attendance of three hundred the Minnesota Academy of Science held its third annual meeting at the University of Minnesota on Saturday, April 13 The program contained 8 papers, as follows "Fifty Years' Experience in the Weather Bureau," Mr U G Purssell, formerly head of Minneapolis Weather Bureau, 'Scientific Concentrates," Dr W C Croxton, State Teachers College, St Cloud, "The Rhythm of Blossoming in Flowering Plants with Special Reference to Hay Fever," Dr C O Rosendahl and A O Dahl, University of Minnesota, "Soil Erosion Demonstration Areas in Southeastern Minnesota," R H Davis, Soil Erosion Service, U S Department of the Interior, "Shelterbelts—Futile Dream or Attainable Benefit," Dr J E Aikman, senior botanist, Lake States Forest Experiment Station, "A Configurational Approach to the Study of Sound," Dr A R Root, Hamline University, "Utilization of Some Farm Wastes," Dr C A Mann, University of Minnesota, "Milking the Rubber Tree," Dr E C Stakman, University of Minnesota.

The academy voted to cooperate with the American

Association for the Advancement of Science at the time of its meeting in Minneapolis

The following officers were elected

President, Dean Edward M Freeman, University of Minnesota

Vice president, Dr L M Gould, Carleton College

Secretary treasurer, H K Wilson, University of Minnesota

Councilor, Dr L H Powell, Director of the St Paul Institute of General and Applied Science

The next annual meeting will be held in Northfield, Minnesota, with Carleton and St Olaf Colleges as hosts

H K WILSON,
Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

ON AN ARRANGEMENT FOR STUDYING THE CONDITIONS WITHIN DIFFUSION LAYERS

VERY few experimental studies are concerned with the manner in which the concentrations and electrical potential are built up in the boundary between two different solutions, across which boundary diffusion takes place From the theoretical side the main interest has so far been the diffusion or liquid junction potential In order to calculate this potential Planck[1] and Henderson[2] have developed theories which differ in assumptions regarding the ionic composition in the diffusion layer (boundary), Planck's theory, derived from Nernst's[3] treatment of electrolyte diffusion, claims that individual ions may under certain circumstances become accumulated in the diffusion layer in higher concentrations than are present in the two surrounding solutions (*cf* Plettig,[4] Planck[5]) Henderson, on the other hand, assumes that all ionic concentrations fall off linearly in the boundary The experimental efforts to settle which theory is valid have, as far as the author has been able to find, used only measurements of the electrical potential (for literature *cf* Plettig and Planck) The question is hardly settled as yet

To judge from the theories, however, the evaluation of the ionic concentration distributions within the diffusion layer should offer more conclusive evidence than can be obtained from the potential measurements, which, as a rule, should theoretically not differ much

Trying to measure the concentration distribution the author first used a diffusion boundary consisting of an agar plug in a glass tube On the two sides of the plug large volumes of the stirred solution were placed After a sufficiently long time the plug was sliced in parallel sections and analyses were performed This method, employed to some extent by previous workers on the "Liesegang structures," however, did not prove to be convenient for observing the development of the final steady state, nor was it good for following the behavior of the potential within the layer

In order to obviate these disadvantages the following arrangement was adopted A number of Cellophane or collodion sheets (5 to 9) were clamped between suitable washers in such a manner that about 10 cc of solution could be placed in each of the chambers" so obtained The two outside "chambers" were fed continuously with the solutions under investigation by means of a special air lift suction pump The content of each 'chamber was stirred With microanalyses on samples from the chambers" (apparently corresponding to different surface elements in the diffusion layer) the building up of the concentrations and potential could be conveniently followed (It should be emphasized that this multimembrane arrangement is not equivalent to one homogeneous diffusion layer from a kinetic point of view But when the time factor disappears, *i e*, in a stationary state, the conditions in the chambers" correspond to those in the interfaces of a sliced" homogeneous diffusion layer) When a steady state' was attained (generally within 24 hours) the results of the experiments showed conclusively in all hitherto investigated cases that the behavior of the ionic concentrations, at least qualitatively, was in accord with the Planck Plettig predictions

This "multimembrane" method has also been useful in investigations of cases of diffusion where chemical reactions take place

The details of the results here referred to and some attempts to discuss the biological importance of these rather peculiar conditions in a 'membrane' will be published elsewhere

TORSTEN TEORELL

THE LABORATORIES OF
THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
NEW YORK CITY

[1] M Planck, *Wied Ann*, 40 561, 1890

[2] P Henderson, *Z physik Chem*, 59 118, 1907

[3] W Nernst, *Z physik Chem*, 2 617, 1888, 4 154, 1889

[4] V Plettig, *Ann Physik*, 5 735, 1930

[5] M Planck, *Sitzb preuss Akad Wiss*, *Physik math Klasse*, 1930, 367, 1931, 113

A SIMPLE RELIABLE TIME CLOCK

IT is not infrequent that workers in physiological laboratories supplied with direct current, where syn-

chronous motors can not be used, feel a very acute need for an inexpensive, transportable time clock to activate more than one time signal A device fulfilling these specifications has been in use in this laboratory for the past year and has been found reliable and accurate The apparatus has a further advantage in that it is inexpensive, costing, exclusive of the mechanic's time, less than $15 00

It is essentially a rotating switch driven by means of a direct current electric phonograph motor These direct current motors may be obtained regulated by a governor to run at a normal speed of 78 revolutions per minute This speed, however, may be increased or decreased by as much as twenty revolutions per minute in either direction Hence it is possible to regulate the motor to obtain one revolution per second For our ordinary laboratory work we use two models and find them adequate for most physiological class work The first, so regulated as to produce one revolution per second, drives a rotating spring contact directly The second has the shaft speed reduced by means of a worm and gear to one revolution per minute In both cases the rotor makes a contact every 90° Thus, in the direct drive, signals are given at 1, 0 5 and 0 25 second The second model gives signals at one minute or 30 seconds or 15 seconds It is used primarily for either slow muscular contractions *i e*, uterine or for respiratory or metabolic determinations The details of the rotating switch and its electrical connections are given in Fig 1

The rotor is fastened directly to the shaft, which is also grounded to the battery The circuit is closed when the rotor strikes one of the four induction switch

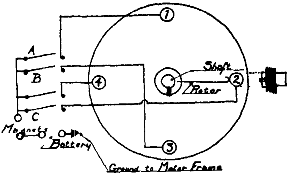

FIG 1

points (1 2-3-4) These points are inserted 90° apart in a vulcanite disk

Thus, closing switch A or B, one contact per revolution is made, closing the double pole switch (C) gives two equidistant contacts, closing all switches causes four contacts or a minimum time interval It has been found advisable when a heavy electrical load is placed upon the contacts to use a two microfarad condenser in order to reduce the spark and so preserve the smoothness of the contacts The entire unit is most compact Even with the relatively large reducing gear it may be enclosed in a small box and easily transported from laboratory to laboratory Since the motor is very quiet we have found it advisable to connect a small lamp in the motor circuit as an indicator to prevent battery wastage

G B RAY
H LEWINE
LONG ISLAND COLLEGE OF MEDICINE

SPECIAL ARTICLES

MUTATION RATE FROM OLD DATURA SEEDS

THE cytological aberrations in root tips of *Crepis* plants from aged seeds, found by Navashin,[1] seemed to point to an influence on mutation rate by conditions that might be obtained in nature Last year we reported high rates of pollen abortion mutations from seeds of *Datura stramonium* that were aged by storing up to ten years in the laboratory [2] The same material has since shown that aging seeds induces also a high rate of visible recessive mutations [3] Later, through the cooperation of H B Derr, county agent at Fairfax, Va, we obtained seeds that, apparently, had been buried for 22 years in the soil beneath a house

These seeds, so far as we are aware, are the only material of the kind which has been subjected to genetic study In view of the suggestions from earlier work that mutations induced by aging seeds may play a role in evolution in nature, it seems desirable to give the evidence upon which we base our belief that these seeds had remained undisturbed for at least 22 years The house under which the seeds were found was built about 1909, and was bought by Mr Derr in 1911 The kitchen was added in 1912 In 1924 a cellar was dug beneath part of the house in order to install a furnace The excavated soil, piled outside, yielded a large crop of vigorous jimson weeds Ten years later, in the spring of 1934, Mr Derr took some soil from under the house and again obtained a number of jimson weeds In June, 1934, one of us visited Mr Derr's

[1] M Navashin, *Nature*, 131 436, 1933

[2] J L Cartledge and A F Blakeslee, *Proc Nat Acad Sci*, 20 103-110, 1934

[3] A F Blakeslee and A G Avery, Abstract, *Amer Nat*, 68 466, 1934

house and with him dug out four bags of soil at a depth of about two to eight inches from unexcavated parts of the cellar. From these soil samples more than 500 Datura plants, together with 168 plants of other genera, chiefly *Acalypha* and *Chenopodium*, were grown at Cold Spring Harbor. There seems to have been no possibility of seeds being carried into this location after the building of the house and its kitchen. The foundation walls (brick for the house and concrete for the kitchen) extend below the ground surface and also about two feet above this level to the floor of the house. A small, externally shielded ventilator was well above the ground line; the outside cellar door was covered, and the closed windows were under the porch. The soil was a hard, dry clay.

Controls were grown from seed of wild plants on Mr. Derr's farm, harvested in 1933, and from the standard inbred Line 1 which furnished test and control seed for our aged seed experiments. Because of a change in the sampling method a higher proportion of the pollen abortion mutations that actually occurred may have been found in the 1934 experiments than was found in 1933. In 1934 a flower from each of the two main forks of each plant was examined, while in the 1933 season the two flowers were taken at random and were, no doubt, in many cases from the same main branch. Since most of the mutations involve sectors of half or less than half of a plant, more may be expected to be found by the method of sampling both main forks. The results from these 22-year-old seeds and their controls are shown in Table I.

TABLE I

POLLEN ABORTION MUTATIONS (TWO-FLOWER SAMPLES)

From seeds—	Plants	Mutations	Percentage
RECORDS OF 1934			
Buried 22 years	427	8	1.8
1-year-old, control	47	0	0.0
1-year-old, Line 1 control	261	3	1.1
RECORDS OF 1933			
Aged 5 to 10 years in lab. (Line 1)	405	32	7.9
1-year-old, Line 1 control	331	2	0.6

One of the eight mutations found seemed to involve the whole plant; the others occurred in sectors of the plants. Five had the appearance of chromosomal mutations and three of the gene mutation type.

Heat treatment of barley[4] and *Crepis*[5] seeds is reported to have given effects like those of aging seeds. Line 1 plants from seeds that were treated at the Boyce Thompson Institute, through the cooperation of Dr. Wm. Crocker and Miss L. V. Barton, are now being grown for mutation rate studies. Preliminary tests have shown that mutations may be induced in *Datura* seeds by heat treatment and that the moisture content of the seeds subjected to heat is of great importance in this connection.

Plants from the buried seeds under discussion are not strictly comparable with our standard Line 1 used as a control, although there is no evidence that the two races would be expected to differ in mutability. The rate of pollen abortion mutations found in the 22-year-old seed plants is scarcely higher than that in the controls, and is much lower than that found in 1933 for seeds aged five to ten years in the laboratory. Taken as they stand, these results indicate that seeds buried in the soil under these more or less natural conditions were unaffected by whatever influences there may be to induce mutations, and that age alone does not greatly, if at all, increase the mutation rate.

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COLD SPRING HARBOR, N. Y.

[4] F. Peto, *Can. Jour. Res.*, 29: 349–362, 1933.

[5] M. Navashin and P. Shkvarnikov, *Nature*, 132: 482, 1933.

[6] Aided by a research grant from the Penrose Fund of the American Philosophical Society.

THE RELATION OF WATER AND ELECTROLYTES TO METABOLISM

A CONSIDERATION of the views held regarding the regulation of water by the living organism reveals an interesting fact. Most workers in this field have stressed the physico-chemical aspects of the problem and have adopted what is essentially a non-vitalistic concept of water balance. Thus Fischer[1] regarded acidosis as being the primary factor in water retention. Schade[2] has emphasized alkalosis. Gamble[3] and his co-workers considered that the total amount of water was determined by the total electrolytes present in the organisms. Starling[4] pointed out the importance of the colloid osmotic pressure of the blood. Davis and Dragstedt[5] have shown how acidosis diminished the ability of the body to retain water. All this evidence points to a mechanistic concept of water regulation. In order to examine further the truth of this purely physico-chemical explanation of

[1] N. H. Fischer, "Oedema," pp. 209, New York, 1910.

[2] H. Schade, *Ergebn. inn. Med.*, 32: 425, 1927.

[3] J. L. Gamble, N. C. Putnam and C. F. McKhann, *Am. Jour. Physiol.*, Vol. 88, p. 571.

[4] E. H. Starling, "Fluids of the Body," pp. 186, 1909.

[5] H. A. Davis and L. R. Dragstedt, *Am. Jour. Physiol.*, 109: 88, 1934.

water balance, this investigation was undertaken The very essence of the non vitalistic theories is exemplified by the fact that salt water is retained much better by the body than is salt free water

A preliminary series of over 25 dogs was used Isotonic solutions of 0 9 per cent NaCl solution and 5 per cent glucose solutions were injected intravenously in amounts from 2,500 cc to 4,000 cc The oxygen consumption of the animal was measured before during and after the injection at standard intervals In all the animals a considerable increase in the oxygen consumption occurred from 100 per cent to 500 per cent above the basal level The increase in O_2 consumption produced by equal amounts of 5 per cent glucose solution was greater than that produced by 0 9 per cent sodium chloride solutions The amount of water lost was proportional to the increase in the oxygen consumption and metabolic rate In 3 animals in whom an increased oxygen consumption did not occur during the injection death occurred Water given by the alimentary tract increased the consumption but slightly This is interesting in view of the fact that fluid by mouth is retained for longer periods than is fluid given by vein Conversely it was found that repeated blood letting lowered the metabolic rate In such animals isotonic solutions were retained for longer periods

Moreover the diuresis was quite limited In the light of these findings, it might be suggested that one of the fundamental factors concerned in water regulation is the oxygen consumption rate of the body tissues Further work is proceeding along these lines

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CALCIFYING FACTORS IN THE DIET OF SALAMANDER LARVAE

THE degree of calcification in salamander larvae was controlled by different calcifying agents, by variations in the Ca P ratio or level and by use of diets with unlike growth promoting properties The results recorded by x rays showed that salamander larvae do not differ widely from higher animal forms in their responses to calcification factors in the diet

Larvae of *Triturus viridescens* fed on a synthetic diet of powdered beef muscle with cod liver oil but without mineral addition were almost devoid of skeletal ossification In contrast, a good calcification of skull and vertebral column appeared in other larvae, of the same age and origin, growing at like rate on a diet of milk powder combined with crude casein and containing the above vitamin D supplement A poorer bone deposit in the limbs suggested that the ratio of calcium to phosphorus or the level of these minerals in the diet was not optimum for the contained vitamin D Analyses for the calcium in the total ash of animals from the two diet series gave figures forming a ratio slightly less than that of the calcium in their diets

The availability of vitamin D from the three common sources and the relative quantities needed for calcification in salamanders were indicated in feeding larvae of *Amblystoma tigrinum* on a synthetic milk diet During a period of two weeks, a more extensive calcification was produced by exposure to ultra violet light (2 or more minutes on alternate days at 112 cm from a Burdick mercury vapor quartz lamp) or by feeding viosterol (1 R U to 10 gm of ration) than by cod liver oil (3 Steenbock R U to 10 gm of ration) Use of the milk diet without vitamin D supplement was not followed by as complete a lack of bone minerals as resulted when other larvae from the same lot of *A tigrinum* were fed on the low calcium meat diet with the cod liver oil This may have been due to the presence of some of the calcifying factor in the concentrated powdered form of milk or to the fact that the high degree of purification of the casein in this milk diet caused a lower growth rate and consequently a smaller rachitic tendency

Larvae of *A tigrinum* fed on the beef muscle diet with cod liver oil but without mineral addition developed a bowing of the limbs typical of rickets, and this disease was sometimes indicated also by weakness at the limb attachment or by abnormal contour of jaws or of spine Yet, even on the extremely low calcium content of the muscle diet, when the vitamin D supply was raised by irradiation (seven minutes on alternate days during two weeks), a fair bone deposit was made On the beef muscle diet with cod liver oil the bone deposit increased as the calcium was raised, until the phosphorus became the limiting factor, and an indication was given that the range of the Ca P ratio required for salamanders is very like that needed by mammals and by the chick

The sensitivity of response to variations in calcifying factors shown by these small urodeles, as well as the ease and practicability with which they serve for x ray studies, points to a convenient means for biological assay of calcifying agents

ESTHER M PATCH

THE UNIVERSITY OF WISCONSIN

BOOKS RECEIVED

LEYBURN JAMES G *Frontier Folkways* Pp x + 291 Yale University Press $3 00

SCHRÖDINGER ERWIN *Science and the Human Temperament* Translated by James Murphy and W H Johnston Pp xxiv + 192 Norton $2 50

Tôhoku Imperial University Science Reports Vol XXIII, No 5 First Series (Mathematics, Physics, Chemistry) Pp 259 + 9 Maruzen Sendai

SCIENCE

VOL. 81 FRIDAY, MAY 24, 1935 No. 2108

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE MINNEAPOLIS MEETING

Edited by Dr. HENRY B. WARD
PERMANENT SECRETARY

THE summer meeting of the association will be held this year in Minneapolis, Minnesota, from Monday, June 24, to Saturday, June 29, inclusive. This will be the ninety-sixth meeting of the association and the third to be held in that city. The thirty-second meeting in August, 1883, and the sixty-second in December, 1910, were those previously held in Minneapolis. It will be interesting to recall briefly something of those early meetings.

On both occasions the University of Minnesota acted as host for the sessions and both are recorded as well attended and well provided with all those conditions needed to insure a successful scientific congress. This year the university again welcomes the association and this time to its new campus, widely recognized as one of the most beautiful, capacious and well arranged among the campuses of the great state universities. The evening general sessions and most of the sectional and society meetings will be held in lecture rooms on the Minneapolis campus, but use will also be made of facilities on the University Farm campus in St. Paul.

The meeting in August, 1883, was an early venture into the Northwest, being the third held beyond the Mississippi River. Out of a total membership of 2,033 the registration, visitors included, reached 328. In all 168 papers were listed in the program and the proceedings of the meeting. These, printed in full by the association, made up an impressive volume of 508 pages, one of the largest in the entire series. At

the meeting in December, 1910, the registered total attendance was 663 and the membership roll included 8,012 names About 530 papers were programmed for various sessions The practice of issuing a volume that contained all the papers presented at the meeting had been abandoned some years before 1910 The eleven sections then existing met in conjunction with related affiliated societies and legislation was adopted approving and perfecting this general plan, which has since been followed whenever such affiliated societies are in session at the meeting

Again this year, as has proved advantageous previously, emphasis is laid in programs of sections and societies on symposia and joint sessions Even greater provision is made for field trips near Minneapolis and some are planned to areas of especial interest in more distant parts of the state The occasion is certain to afford varied opportunities for scientific contacts and studies

Local Committee, Officers of Sections and Cooperating Organizations

The general chairman of the local committee is Dwight Elmer Minnich, professor and chairman of the department of zoology at the University of Minnesota, the general secretary is Donald Gildersleeve Paterson, professor of psychology, University of Minnesota About forty members of the association and cooperating organizations are engaged as members of committees and subcommittees arranging programs and entertainment for the meeting The following sections with the officers indicated have arranged the particular programs and the facilities for the meetings of the sections and the associated societies meeting in Minneapolis at this time

In Mathematics Professor Dunham Jackson is acting secretary and Professor William L Hart local representative In Physics the acting secretary is Professor John T Tate, and Dr Henry A Erikson is local representative The American Meteorological Society is meeting with the section The American Physical Society is meeting in Minneapolis on June 21 and 22, just prior to the opening of the association meeting In Chemistry Professor Samuel C Lind is acting secretary and local representative In Astronomy Professor Willem J Luyten is acting secretary and local representative The Society for Research on Meteorites will meet in conjunction with the section In Geology and Geography the acting secretary and local representative is Professor Frank F Grout

In the Zoological Sciences Professor William A Riley is acting secretary and local representative The Parasitologists will meet with the Zoologists In the Botanical Sciences the acting secretary is Dr Loren C Petry and the local representative Professor C O Rosendahl The Botanical Society of America, the American Society of Plant Physiologists and the American Phytopathological Society are meeting with the Botanists The Ecological Society of America will meet with the Zoologists and Botanists In Anthropology Professor W M Krogman is secretary and the local representative is Professor Albert E Jenks In Psychology Professor John E Anderson is acting secretary and local representative In Social and Economic Sciences the acting secretary is Professor F Stuart Chapin, and Roland S Vaile is local representative The American Sociological Society joins with the section

In the Medical Sciences the secretary is Dr Vincent du Vigneaud and the local representative is Dr W A O Brien The American Pharmaceutical Association will meet jointly with the section A local branch of the Society of American Bacteriologists is considering meeting in conjunction with the Section on Medical Sciences

In Agriculture Professor H K Hayes is acting secretary and Dr Walter C Coffey is local representative The American Society of Agronomy (Corn Belt Section), the Dairy Science Association, the Great Plains Section of the American Society for Horticultural Science, the Genetics Society of America and the Association of Official Seed Analysts are meeting with the Agriculturists In Education the secretary is Professor William S Gray, and Professor Harold Benjamin is local representative

Joint Meeting with Minnesota State Medical Association

An unusual feature of the Minneapolis meeting is found in the arrangement for joint sessions and an exchange of privileges with the Minnesota State Medical Association, which is to hold its eighty second annual meeting in Minneapolis from Monday, June 24, to Wednesday, June 26 The American Association has arranged with the Minnesota society to hold a joint general session on Monday evening, at which the speaker will be Dr W P Murphy of Boston, who comes on the invitation of the Minnesota State Medical Association The privileges of the evening general sessions and other meetings of the American Association and its sections have been extended to all members and visitors registered for the Minnesota State Medical Association In return the members of the American Association have been invited to attend any of the lectures or scientific demonstrations and exhibits as guests of the medical society The A. A. A. S badge will serve as sufficient identification for admission

Joint sessions of the Section on Medical Sciences and the medical society have been arranged on Monday and Tuesday mornings On Monday morning Dr

Hansen, of Faribault, Minnesota, will give a paper on the "Biological Effect of Thymus and Pineal Extracts," and Dr Cutler, of Chicago, will discuss "The Recent Advances in the Treatment of Cancer" In the afternoon three very interesting papers will be given on clinical allergy, hyperthyroidism and the pathogenesis of gall bladder disease On Tuesday morning a joint session will be held with the Section on Medical Sciences for a symposium on diseases of the blood In the afternoon of the same day Dr Brown, of Boston, will discuss the "Inception and Development of Fluoroscopy," Dr Sevringhaus, of Madison, will present a paper on "Endocrine Therapy," and Dr Plass, of Iowa City, will discuss "Simplification of Obstetrical Care" At ten o'clock and at two on both Monday and Tuesday, scientific demonstrations and exhibits will be shown by the Minnesota State Medical Association Many of these will be of much interest to the members of the American Association Various exhibits concerning cancer, prevention of deafness, mental health, physical therapy, tuberculosis and the like will be shown An interesting series of exhibits will also be presented concerning the endocrines, including a very extensive one concerning diabetes mellitus

Headquarters and Registration

General headquarters for the meeting and the main registration office will be in the lobby of the Northrop Auditorium on the University of Minnesota campus, in Minneapolis The building is centrally located with reference to all other buildings on the campus and will be a convenient social gathering place for members attending the meeting The office of the permanent secretary will also be located in this building Officers of the association will be quartered in the Hotel Nicollet, which will be hotel headquarters Mail, telegrams, etc, may, if desired, be addressed to Headquarters, A A A S, Northrop Auditorium, University of Minnesota, Minneapolis Minn

Registration will be open, upon payment of a fee of $1 00, to all persons who are interested in the advance of science or education Each registrant receives a copy of the program, an identification card and a badge Registration will be necessary for attendance upon the general reception, participation in excursions and other events

Transportation

Reduced railway rates on the receipt certificate plan have been granted by almost all railroads in the United States and Canada The only exceptions are a few short lines in the Southwestern Passenger Association

Persons attending the meeting should purchase a first class, one way ticket to Minneapolis, securing a receipt certificate reading "For the American Association for the Advancement of Science and Associated Societies, and the Minnesota State Medical Association" The certificate must be left at the registration desk for endorsement and validation, to be called for later in the same place Each person presenting an endorsed and validated certificate may purchase a return ticket for one third of the regular fare, on the same route as used in going to Minneapolis Tickets to Minneapolis from many points may be purchased between June 19 and 25, although from far western

HOTEL ACCOMMODATIONS IN MINNEAPOLIS

Name of Hotel	Address	Minimum rates			
		Without bath		With bath	
		Single	Double	Single	Double
Nicollet (General Headquarters)	Washington and Nicollet	$2 00	$3 50	$2 50	$4 00
Curtiss	10th and 3rd to 4th Avenues			2 00	3 00
The Leamington	10th and 3rd Avenue, South			2 00	3 00
Radisson	45 S 7th Street	2 00	3 50	3 00	4 50
Sheridan	1112 Marquette Avenue	1 25	1 75	2 00	2 50
West	Hennepin at 5th Street	1 25	2 00	1 75	2 50
Andrews	Hennepin at 4th Street	1 50	2 50	2 25	3 25
Dyckman	27 South 6th Street			2 00	3 00
Vendome	17 S Fourth Street	1 00	1 50	1 50	2 50
Maryland	1346 LaSalle Avenue			1 50	2 50
Francis Drake	10th and 5th Avenue South			2 00	2 50
Hastings	12th and Hawthorne Avenue			1 50	2 25
Buckingham	1500 LaSalle Avenue			2 00	2 75
Field	510 S 8th Street	1 25	2 00	2 00	2 50
Oak Grove	230 Oak Grove			2 00	3 00

points they may be purchased as early as June 17 Return tickets must be purchased by July 3 and in most instances these tickets will be good for thirty days, including date of sale of going ticket, as shown by selling agent s stamp on certificate

The privilege of reduced rates is limited to bona fide members of the association and its associated societies and the Minnesota State Medical Association and immediate members of their families

Persons residing outside the regions of reduced rates should each purchase a round trip ticket to the nearest station issuing through tickets to Minneapolis and situated within the region of reduced rates On arrival at that station a one way ticket to Minneapolis and a certificate, as directed in the preceding paragraph, should be secured

In view of the fact that the railroads are likely to announce special summer excursions, it is advisable to consult the local ticket agent It is advisable also to consult the agent regarding the various periods when going tickets may be purchased on the certificate plan

The Andrews, Dyckman, Hastings, Nicollet, Radisson, West and Vendome hotels are within one block or less of street cars, which run direct to the university, the Buckingham, Curtis, Field, Francis Drake, Leamington, Maryland, Oak Grove and Sheridan are three blocks or further from the direct car lines but are close to other car lines which have transfer connections with these lines The buses to the university either pass the door or within two blocks of the Andrews, Dyckman, Nicollet, Radisson, Vendome and West hotels The street car running time directly to the university is 12 minutes and the bus 12 minutes

General Sessions

The evening general sessions will all be held in the Northrop Auditorium on the Minneapolis campus of the university The opening session on Monday evening will be a joint session with the Minnesota State Medical Association Dr Karl T Compton, president of the American Association, and Dr W A Coventry, president of the Minnesota State Medical Association, will preside The address will be given by Dr W P Murphy of Boston, on the subject "Diseases of the Blood" At the general session on Tuesday evening, which will be the Maiben lecture, Dr Richard P Strong, of the Harvard University Medical School, will speak on the topic "The Importance of Ecology in Tropical Disease" This will be followed by an informal reception given by President L D Coffman, of the University of Minnesota, and Mrs Coffman for the visiting scientists Dr Isaiah Bowman, director of the American Geographical Society, will address the general session on Wednesday evening, on the subject "The Land of Your Possession" At the Thursday evening general session Dr Wm F G Swann, director of the Bartol Research Foundation, will speak on "The Nature of Cosmic Rays" The Friday evening address will be given by Dr Philip Fox, director of the Adler Planetarium and Astronomical Museum, on the subject "The Scale of the Universe"

A symposium on "Conservation," organized by the local committee for the Minneapolis meeting, deserves especial mention This will be held on Thursday morning in the Northrop Auditorium The program will cover some of the broad aspects of the problem, and the speakers will include men of national reputation in this field President L D Coffman, of the University of Minnesota, will preside and make the introductory address He will also introduce the speakers This major event of the meeting has been provided through generous cooperation from the university and is aimed to introduce to students of the University Summer School then in session the views of distinguished scientists on this important problem

Social Events

On Tuesday evening following the Maiben lecture President L D Coffman, of the University of Minnesota, and Mrs Coffman will give an informal reception to visiting scientists

The Minnesota State Medical Association will hold its annual dinner on Tuesday evening

A joint luncheon is planned for Tuesday by the Sections on Mathematics, Physics and Astronomy

Phi Lambda Upsilon will hold its luncheon on Wednesday at the Minnesota Union

A dinner under the auspices of Phi Delta Kappa and Pi Lambda Theta, in which the Section on Psychology and the Section on Education will join, is scheduled for Thursday evening

A number of other informal social gatherings for smaller groups and individual societies are being planned

Exhibits and Demonstrations

A number of special exhibits are being planned by various departments of the university The Department of Anthropology will have a number of such exhibits, including the Browns Valley Man and the Minnesota Man An exhibit of early books and manuscripts dealing with natural science will be on display in the lobby of the University Library The Museum of Natural History with its magnificent habitat groups, the Geological Museum, the Herbarium and the entomological collection at the University Farm will hold open house throughout the week Various other departments are planning additional exhibits. The exhibits of the Minnesota State Medical Association are described in connection with the program of the Section on Medical Sciences

THE TWIN CITIES REGION

(By Thomas E Steward, University News Service)

The region of the Twin Cities, including Minneapolis and St Paul, offers many attractions to the visitor who would combine sightseeing with the scientific activities of an association meeting Both cities lie above the Mississippi River, though on opposite banks, St Paul being downstream from Minneapolis On each bank of the river are winding drives that offer the motorist attractive views

In point of actual beauty few cities have more to offer than has Minneapolis In preglacial times the Mississippi flowed through what is now the city, and when the ancient river was diverted by debris the old channel became a chain of lakes, around which the better residence sections have sprung up Parked drives wind past these lakes and follow Minnehaha Creek to the ledge where that famous stream drops to the level of the Mississippi in Minnehaha Fall, so well known from Longfellow's poem During the drier parts of the year the stream and falls are, unfortunately, quite dry Especially beautiful are Lake Harriet and Lake of the Isles, but the others, Calhoun, Cedar and Nokomis, will well repay a visit

Fort Snelling stands at the point where the Minnesota River flows into the Mississippi Dating back to about 1820, it offers many attractive glimpses of the distant past at a Northwest outpost, together with the evidences of more recent developments

Eighteen miles west of Minneapolis lies Lake Minnetonka, once famous as a summer outing place for people from the South and now the site of many fine homes A thirty mile drive around this lake will carry one past many scenes of worthwhile beauty

In Summit Avenue St Paul has one of the outstanding residence streets of the country, and those who go from one city to the other would do well to follow this tree lined route, which is both direct and most attractive

Persons interested in the industrial life of the region will find in Minneapolis many plants devoted to the production of cereal foods, including flour, feed, breakfast foods, macaroni, and the like, also extensive linseed crushing establishments and elevators for the storing of grains and linseed There also are important plants devoted to the fabrication of ornamental products of iron, brass and bronze Nearby, at South St Paul, are extensive packing plants Some of the largest dairy manufacturing plants in the country are to be found in St Paul and Minneapolis, and St Paul is a considerable center of metal fabrication and of the railroad shop and maintenance industry

Among cultural activities there may be listed in Minneapolis the Minneapolis Institute of Arts, the Walker Gallery, the Minneapolis Symphony Orchestra, the University of Minnesota and, a few miles from the main campus, University Farm, in St Paul, site of the College of Agriculture, Forest and Home Economics and of the Agricultural Experiment Station

Among the independent or church colleges in the cities are Augsburg Seminary, College of St Thomas College of St Catherine, Macalester College and Hamline University Two junior colleges, Bethel Institute and Concordia College, are located in St Paul

The background of the business and industrial life of the Twin Cities region is primarily agricultural and arises from the production shipping and manufacture of dairy, cereal, linseed, corn and animal products For those with a special interest in any or all of these, exceptional opportunities for observation will be at hand

Less than twenty miles east of the Twin Cities one comes to the St Croix River, which in early post glacial times drained Lake Superior into the Mississippi, while ten miles south of Minneapolis is the Minnesota River, known to geologists as the River Warren As such it drained Lake Agassiz when that great glacial body of water covered much of northwestern Minnesota and eastern North Dakota

Adjacent to Minneapolis and St Paul is an area of varied agriculture About forty miles southwest lies Northfield, site of the two important independent colleges, St Olaf and Carleton

SCENIC ATTRACTIONS AND VACATION OPPORTUNITIES

Minnesota has vacation opportunities superior to those of a majority of the states in which an association meeting is held Called the state of "Ten Thousand Lakes," it is at least supplied with an unusual number of attractive inland bodies of water, left in particularly large numbers over the northern two thirds of the state by the receding glaciers

Among the larger of the Minnesota lakes are Mille Lacs, 100 miles north of Minneapolis, Leach Lake, about 180 miles northwest of Minneapolis, Cass Lake, just north of Leach Lake, and Lake Winnibigoshish, on the northeast point of a triangle formed with Cass and Leach Lakes Fifty miles northwest of Winnibigoshish lies Red Lake, most remote and largest of the Minnesota lakes, not especially picturesque, but interesting because of the large Indian settlements nearby There also are reservations near the other three big lakes, excepting Winnibigoshish

Scattered throughout the rest of the state, particularly north of Minneapolis and St Paul, lie literally a myriad of other lakes of different sizes and attractions Principal recognized centers from which these can be reached are Brainerd, Alexandria, Park Rapids, Detroit Lakes, Grand Rapids, Ely and Bemidji, and the tourist who finds himself in any of these towns will

have no difficulty in locating a number of splendid outing spots.

Those who wish a rugged outing of the "back yonder" variety had best visit what are called the "border lakes." These are remote lakes of extreme beauty lying along the Canadian boundary. Access to them is gained at the western end through International Falls and Crane Lake, half way across through Ely, via Basswood Lake, and at the eastern end, by way of the Gunflint trail, which runs back to the Canadian border lakes from the town of Grand Marias.

Combined with the eastern border lakes are the attractions of Minnesota's really fine north shore drive, along the northern shore of Lake Superior. From Duluth, Minnesota's big lake port at the apex of Lake Superior, this drive runs northeast to the Canadian border, and across it to Port Arthur, Ontario, and the famous Nipigon River.

The highest and most rugged country in Minnesota lies just inland from the north shore drive and the views of the great freshwater sea, Lake Superior, are superb over most of the 180 miles between Duluth and Pigeon River at the border. Near the latter point one may follow on foot the route of the old Grand Portage, by which French and later British traders found their way inland from Superior to the Pigeon River and the border lakes in their quest for furs.

Just over the Canadian border lies the Quetico area of Canada, one of the finest game areas and canoe trail districts in the world, and similar in these respects to the Minnesota region that it borders. No shooting will be legal in June, but splendid fishing, camping and canoeing will be available.

The St. Croix River, already mentioned, will provide many scenic attractions to those who wish to visit it, while northern Wisconsin is in many respects similar to northern Minnesota, although it ends at the south shore of Lake Superior.

Minnesota in general is made up of a rugged, unglaciated area in the southeast, a rich farming country in the south, a prairie farming region in the southwest and central west, the famous Red River Valley in the northwest, and at the north and northeast cutover forest areas that merge imperceptibly into wilderness as one comes nearer to the Canadian boundary.

In such a state those seeking outdoor recreation may take their pick although, as in any other place, careful advance selection of a route will mean greatly increased satisfaction over the outing.

EXCURSIONS

The following preliminary summary of excursions which are contemplated by various sections and societies is compiled from the reports sent in and is subject to modification. Complete details as to places, routes, starting times, expenses and other important features will appear in the final program to be issued on registration in Minneapolis. Further information may be secured at the special desk in the registration room at the Northrop Auditorium.

General trips will be arranged to visit (1) Minneapolis parks and parkways and (2) Minneapolis mills and milling districts.

The Section on Medical Sciences will meet on Thursday in Rochester at the Mayo Foundation. The morning program there will be devoted to reading papers. In the afternoon the general offices of the Mayo Foundation, the Hygienic Museum and the Experimental Institute will be visited. Members of the section and others interested, especially those in biological sciences, are invited to participate.

Special trips are being planned as follows:

Tuesday afternoon. A field trip to the Minnesota River Valley or the St. Croix River Valley has been arranged by the Section on Botanical Sciences, the Botanical Society of America and other botanical organizations, in which the Ecologists will join. The afternoon will also be used by the Great Plains Section of the American Society for Horticultural Science for an inspection of horticultural plots at the University Farm, and by the Section on Agriculture and cooperating societies for a field trip to Moscrip's Farm, Lake Elmo, to observe studies of pasture management.

Wednesday (all day). The Section on Botanical Sciences, the Botanical Society of America and other botanical organizations will go on a trip to the Bunker Prairie Region. The Ecologists will either join the Botanists or will go with the Zoologists for an afternoon trip to sand dunes in the vicinity of the Twin Cities. The same afternoon the Plant Physiologists will visit the University Fruit Breeding Farm. The Section on Agriculture and cooperating societies will devote the day to inspecting demonstrations of agricultural research by the University of Minnesota divisions of agronomy and plant genetics and plant pathology and botany at the University Farm. The Great Plains Section of the American Society for Horticultural Science has arranged a field trip for the morning through Como Park, mushroom caves and vegetable growing regions near South St. Paul, and for the afternoon to Faribault to visit nurseries, seed houses, etc., as well as parks and greenhouses in the Twin Cities.

Thursday (all day). The American Society of Agronomy will go to Lake Mille Lacs to observe the High lime Peat Experimental Field at Coon Creek and the Low lime Peat Experimental Field at Page. The American Phytopathological Society has arranged a morning trip to local market garden regions and an afternoon trip to the fruit breeding farm. The Amer-

ican Society for Horticultural Science will visit on Thursday morning the Coon Creek Experimental Farm, vegetable growing areas near Anoka, early potato regions near Osseo and melon districts near Brooklyn Center, and in the afternoon the University of Minnesota Fruit Breeding Farm near Zumbra Heights

Thursday and Friday A two day trip to Itasca State Park, the Cloquet Forest Experiment Station and the north shore of Lake Superior has been planned by the Section on Botanical Sciences, the Botanical Society of America and other botanical organizations In this the Plant Physiologists and Ecologists will join

Friday (all day) The American Society for Horticultural Science has arranged a trip to the Cloquet Forest Experiment Station, Northeast Experiment Station near Duluth, Iron Range, and North Central Experiment Station at Grand Rapids

Additional field excursions for which the dates are not fixed include the following One or two half day trips by the Section on Geology and Geography to places of interest in the immediate vicinity of Minneapolis, a visit by the Plant Physiologists to the laboratories of the Shelter Belt project of the Lake States Forest Experiment Station, and a visit by the American Meteorological Society to Fort Snelling, where meteorological observations, since continued were commenced in 1819 If the number warrants, the Section on Anthropology will make a three day trip to outstanding archeological sites, notably those of Pleistocene Man in Minnesota, with an archeologist or a geologist in charge

SECTION MEETINGS AND SOCIETY PROGRAMS

The Section on Mathematics (A) and the Section on Physics (B) will hold a joint symposium on Tuesday morning on the general subject of methods of solution of differential equations and illustrations of their application to problems in mathematical physics Papers will be presented by Professor R W Brink (University of Minnesota) on "Boundary Value Problems", Professor Rudolph E Langer (University of Wisconsin) on "The Asymptotic Solution of Differential Equations", and Professor David M Dennison (University of Michigan) on "Applications of Approximate Methods to Physical Problems with Particular Reference to Molecular Spectra" On Tuesday afternoon the Section on Physics (B) will meet jointly with the Section on Astronomy (D) A joint luncheon of Sections A, B and D is scheduled for Tuesday The American Physical Society has arranged to hold its summer meeting in Minneapolis on June 21 and 22, just prior to the opening of the meetings of the association

The American Meteorological Society will hold sessions on Thursday, Friday and Saturday The outstanding feature of the meeting will be descriptions of methods of controlling or mitigating the effects of weather The interrelations of climate and forests and the proposed Shelter Belt, the prevention of soil erosion and the construction and management of the nine foot channel of the Mississippi will be the subjects of invited papers by Raphael Zon and Carlos G Bates, consultants for the Shelter Belt, by Walter J Parsons and George O Guesmer, of the U S District Engineer Office, St Paul, and O R Zeasman, in charge of erosion control work in Wisconsin A session devoted to the work of the cooperative climatological observers of the Weather Bureau will be held on Saturday, to which all these observers in the upper Mississippi Valley and Northwest have been invited Arrangements are being made for a visit to Fort Snelling where meteorological observations commenced in October 1819, have been carried on continuously since that date

The Section on Chemistry (C) plans to have a symposium on physiological chemistry, probably on the processes of the digestive tract in cooperation with the Section on Medical Sciences Also the section will have one or two general sessions, depending on the number of contributions, devoted to general papers in the field of chemistry The Minnesota Section of the American Chemical Society is cooperating with Section C and will invite the state sections from neighboring states to meet jointly with the section At least one of the national chemical fraternities will hold its annual meeting in Minneapolis at the same time as the association meeting

The Section on Astronomy (D) will meet with the Section on Physics (B) in a joint session on Tuesday afternoon, at which Dr Otto Struve, director of the Yerkes Observatory, will give the principal address on the subject "Modern Interpretations of Spectra" This will be followed by a session for contributed papers Additional sessions for the presentation of papers may also be scheduled The offices of the Department of Astronomy of the University of Minnesota will be open to all visitors, who are cordially invited to come and inspect the work that is being done A joint luncheon is planned for Tuesday noon with Sections A and B

The Section on Geology and Geography (E) plans a meeting for presentation of papers Thursday morning, also joint sessions with the Section on Anthropology (H) Half day field trips to places of interest in the immediate vicinity of Minneapolis are in mind The department of geography of the University of Minnesota is considering a field excursion The Society for Research on Meteorites has sessions on Wednesday and Thursday which will interest geologists It may be that the Eastern Section of the

Seismological Society of America will also hold a meeting in Minneapolis at this time

The Section on Zoological Sciences (F) will present a symposium on hormones on Wednesday morning In the afternoon the section will meet jointly with the Ecological Society of America for a field trip to sand dunes in the vicinity of the Twin Cities Thursday morning's session will give place to the association program on conservation On Friday the American Society of Parasitologists will conduct jointly with the Section on Medical Sciences a program of invited papers in the field of animal parasitology Among these papers are one on North American and other ticks in relation to the transmission of Rocky Mountain spotted fever, and others by prominent investigators on "Characteristics of *Diphyllobothrium latum* in Canada," "Problems in the Study of Onchocerciasis," "The Rickettsia like Microorganism of *Culex pipiens* " "The Rôle of Fleas and Ticks in the Spread of Tularemia," "The Significance of Recent Studies on Lung Flukes in the United States," "The Life Cycle of *Prosthagonimus macrorchis*," "The Zoology of Cercarial Dermatitis," "Stages in the Life History of *Spiroryx contortus*," "The Use of Calcium Chloride in Parasitological Technique and "The Fox Lungworm, *Capillaria aerophila* " This will be followed by an afternoon program of demonstrations by the American Society of Parasitologists, for which an extensive series of unusual exhibits is pledged

The Section on Botanical Sciences (G), in cooperation with the Botanical Society of America and other botanical organizations, will hold a session on Monday evening with one or two invited papers, followed by a reception or smoker A program of invited papers is scheduled for Tuesday morning and a field trip, either to the Minnesota River Valley or the St Croix River Valley, for Tuesday afternoon, a trip to the Bunker Prairie region for Wednesday and a trip to the Cloquet Duluth region for Thursday and Friday Tuesday and Wednesday evenings are to be devoted to informal discussions, with possibly a dinner on Tuesday evening The American Society of Plant Physiologists will participate in three joint sessions as follows with the Botanical Society of America on Monday afternoon, on Tuesday morning with the Section on Agriculture in a symposium on "Improving the Germplasm of Domestic Plants and Animals," with addresses by Dean W C Coffey, Hon H A Wallace, Dr Jay L Lush and F D Richey and on Wednesday afternoon with the American Society for Horticultural Science, followed by a field trip to the University Fruit Breeding Farm A session for the presentation of papers will be held on Wednesday morning, followed by a symposium on dormancy, after ripening and germination of seeds On Thursday and Friday the Physiologists will join the Botanists in their field trip to Itasca State Park, the Cloquet Forest Experiment Station and the North Shore of Lake Superior Their program also includes inspection of laboratories and demonstrations of research work in progress in the physiological laboratory of the University of Minnesota Department of Botany as well as the Section of Plant Physiology at the University Farm, and also laboratories of the Shelter Belt project of the Lake States Forest Experiment Station

The Ecological Society of America, under the joint auspices of the Sections on Botany and Zoology, plans to hold a session on Tuesday morning with invited papers dealing with local flora and fauna The Ecologists will join the Botanists in their field trip on Tuesday afternoon to the Minnesota River Valley, where are to be found a typical forest of the region, wet meadows and seepage bogs at the base of bluffs, with unusual vegetation An all day field trip is planned for Wednesday, either with the Botanical Society to the Anoka Sand Plain, or with the Zoologists and Animal Ecologists On Thursday and Friday the Ecologists will join the Botanists in their trip to northern Minnesota

The Section on Anthropology (H) will hold three morning sessions On Thursday the session will be devoted to the discussion of archeological problems of the Upper Mississippi area Dr A E Jenks will discuss Pleistocene Man in Minnesota L A Wilford will present data on Minnesota prehistory, and A W Bowers will talk on the archeology of the Dakotas At the Friday session the principal speaker will be Mark L Burns, an Indian agent in charge of the Great Lakes area, who will present an outline of government policy in this area Dr Florence Goodenough will discuss primitive mentality and Miss Frances Densmore will read a paper on Indian songs Dr W M Krogman will give an illustrated talk on proto historic and early historic races of Asia Minor The Saturday session will be given over to child growth studies Dr R E Scammon will discuss growth trends, Dr W D Wallis will read a paper on anatomic growth rate, and Dr C H McCloy will outline the statistical approach to the analysis of growth factors at varying ages The afternoons have been left open to provide an opportunity to study the important archeological material housed in the department of anthropology of the University of Minnesota, under the care of Professor A E Jenks In addition there will be time to visit archeological sites on the outskirts of Minneapolis If the number warrants, a three day trip to outstanding archeological sites, notably those of Pleistocene Man in Minnesota, will be arranged, with an archeologist and a geologist in charge

The Section on Psychology (I) will meet jointly

with the Section on Education (Q) on Friday morning in a session for contributed papers On Thursday evening these sections will participate in a dinner held under the auspices of Phi Delta Kappa and Pi Lambda Theta, at which Professor John E Anderson (University of Minnesota) and Professor F B Knight (University of Iowa) will deliver addresses On Saturday Section I will hold a session for the discussion of 'The Measurement of Attitudes"

The Section on Social and Economic Sciences (K) will hold morning sessions on Tuesday, Wednesday and probably also Thursday for the presentation of papers among which are the following (1) "The Effect of the Depression on Mortality and Morbidity," by Dr Louis Dublin, (2) 'Recent Population Movements," by Dr Carter Goodrich, from the S S R C study of this problem, (3) "Income Redistribution," by some one from the Brookings Institution (4) 'Land Use and Its Effect on Population Trends,' by Professors Kolb and Nowell, of the University of Wisconsin, (5) 'The Fertility of Families on Relief, by Dr Clark Tibbitts, of Chicago, (6) 'Housing Problems,' by Professor James Ford, or "Basic Studies Behind Housing," by Shelby Harrison The American Sociological Society is cooperating

The Section on Medical Sciences (N) has arranged a comprehensive program, including both general and special subjects, and will hold sessions on the mornings of Monday, Tuesday, Wednesday, Thursday and Friday, the Monday, Tuesday and Friday session to be joint meetings with the Section on Chemistry (C), the Minnesota State Medical Association and with the Zoologists and Parasitologists, respectively

The joint session with the Section on Chemistry (C) on Monday will include papers dealing with the chemistry of certain hormones and other subjects The joint session with the Minnesota State Medical Association on Tuesday morning will consist of a symposium on "Diseases of the Blood" The subject of "Agranulocytosis" will be discussed by Dr Theodore L Squier of Milwaukee Dr Walter A Bloedorn, School of Medicine, the George Washington University, Washington, D C, will discuss "Iron Therapy," and Dr William P Murphy, Harvard Medical School, Boston, Massachusetts, will discuss "Liver Treatment" After the scientific demonstrations and exhibits have been presented Dr Louis W Sauer, of Northwestern University Medical School, will speak on "The Prevention of Whooping Cough with Bacillus Pertussis Vaccine" On Wednesday morning Section N will have a group of interesting papers covering various subjects

On Thursday morning, June 27, Section N will hold its meeting at the Mayo Foundation in Rochester, Minnesota Dr William J Mayo will welcome the visitors to the Mayo Clinic and interesting papers will be presented by members of the staff of the Mayo Clinic and visiting scientists, including Professor L H Newburgh, of the University of Michigan, and Professor E L Sevringhaus, of the Medical School of the University of Wisconsin The afternoon will be devoted to visiting the Experimental Institute, the Hygienic Museum and the General Offices of the Mayo Foundation

On Thursday morning, while Section N is meeting in Rochester, there will be a meeting of the subsection on Pharmacy in Minneapolis, at which several interesting papers will be presented

On Friday morning the joint program with the American Society of Parasitologists will include papers by Dr R R Parker U S P H S, Dr R A Wardle, the University of Manitoba, Dr Richard P Strong, Harvard Medical School, Dr Marshall Hertig, Harvard Medical School, Dr R G Green, University of Minnesota, and Dr D J Ameel, Augustana College, South Dakota

Of especial interest to members of the Section on Medical Sciences will be the exhibits and demonstrations of the Minnesota State Medical Association mentioned elsewhere These are shown in the Minneapolis Municipal Auditorium from 10 to 12 and 2 to 3 Monday and Tuesday The badge of the A A A S will serve for admittance In addition to the commercial displays there will be a large number of scientific displays sponsored by the University of Minnesota, the American Medical Association, the Mayo Foundation, the Council on Physical Therapy, and smaller displays on the treatment of pediatrics, carbon monoxide poisoning, injection treatment of hernia, diabetes and a special heart exhibit The Friday afternoon program of exhibits and demonstrations by the American Society of Parasitologists will also be of interest to members of the Section on Medical Sciences Full details regarding both series of exhibits will be found in the final program

The Section on Agriculture (O) will hold a joint symposium on Tuesday morning in cooperation with the Dairy Science Association, the Corn Belt Section of the American Society of Agronomy, the American Society for Horticultural Science (Great Plains Section), the American Phytopathological Society, the Genetics Society of America and the American Society of Plant Physiologists, on the subject, "Improving the Germ Plasm of Domestic Plants and Animals" Professor H K Hayes, vice-president of the section, will preside The introductory address will be given by Dean W C Coffey, of the University of Minnesota department of agriculture The Honorable Henry A Wallace will speak on the subject "Future Possibilities," and Dr Jay L Lush, of Iowa State College, will discuss "Some Accomplishments with Animals" Dr O S Aamodt, of the University of

Wisconsin, will talk about "Analysis and Synthesis in the Development of New Varieties of Plants" A field trip to Moscrip's Farm, Lake Elmo, to observe studies of pasture management, has been arranged for Tuesday afternoon On Wednesday the section will cooperate with the Phytopathologists, Geneticists and Plant Physiologists in a field trip to observe the work of the divisions of agronomy and plant genetics and plant pathology and botany of the University of Minnesota at University Farm Thursday morning will be devoted to a field trip to Lake Mille Lacs, with visits en route at the High lime Peat Experimental Field at Coon Creek and the Low lime Peat Experimental Field at Page, twelve miles south of Lake Mille Lacs

The Section on Education (Q) will hold four sessions, on Thursday and Friday morning and afternoon, for the presentation of reports on research studies on (1) school administration, (2) the improving of learning, (3) understanding the young child and (4) higher education On Thursday evening the section will participate in a dinner held under the auspices of Phi Delta Kappa and Pi Lambda Theta, at which Professor F B Knight (University of Iowa) and Professor John E Anderson (University of Minnesota) will speak.

A DINNER DEMONSTRATION OF THRESHOLD DIFFERENCES IN TASTE AND SMELL

By Dr ALBERT F BLAKESLEE

DEPARTMENT OF GENETICS CARNEGIE INSTITUTION OF WASHINGTON, COLD SPRING HARBOR, N Y

MEAL-TIME is distinctly a time of taste and smell However great may be the appeal to the eye or to the ear in the dinner accompaniments, the primary appeal of food is to the senses of gustation and olfaction At meal time one is most ready to try experiments that involve the senses associated with the consumption of our daily bread The fact that at table the senses in question may be washed, as a slate, clean for a new test by so simple a procedure as a morsel of food and a drink of water is an added reason why a dinner offers a favorable opportunity for a demonstration of peculiarities in taste and smell

The specific occasion about which the editor of SCIENCE has requested a brief account was the biologist's dinner at the Berkeley meeting of the A$_3$S this past June The demonstration was made possible by the cooperation of the management of the International House, where the dinner was held, as well as by that of Dr A E Clarke, who had charge of assembling and distributing the test material and of recording the reactions as expressed by a showing of hands Since nearly 250 persons were present at the dinner it was not possible in the time available to obtain an accurate record in any instance and, in consequence, some of the estimates given below have been reached with the aid of tests made at other times The showing of hands adequately fulfilled its chief purpose, however, which was to demonstrate how different people may be in their reactions to the same stimuli

The first test was called a "preservative cocktail," which was sipped by the diners before they were served with a conventional fruit cup It consisted of a 0 1 per cent solution of benzoate of soda served in paper cups in lieu of wine glasses This is the concentration used commercially in the preservation of food The majority found it tasteless, but to over a quarter of those tested, however, it had a distinct taste which was described for the most part as sweet or bitter A larger proportion are able to taste the dry powder, but this compound has been advertised as a tasteless substance which it is to some, but not to others

Following the fruit cup, each was given two glassine envelopes marked respectively 0 02 per cent and 0 64 per cent The first contained a slip of paper tape which had been dried after being passed through a 0 02 per cent alcoholic solution of PTC (phenyl thio-carbamide) The second paper had been treated with a 0 64 per cent solution and was 32 times stronger The first paper was without taste to the majority and tasted by only about a quarter of the people The second stronger paper was tasted by the majority and was without taste to only about 15 per cent This test was given to show that a substance must have a certain strength of concentration before it can be tasted and that this concentration is different for different people In other words, people differ in their taste thresholds They differ also in the kind of sensation which they appear to get from a substance which they taste PTC, for example, is bitter to most tasters, but a considerable proportion of people report other tastes In an exhibit at the American Museum of Natural History in connection with the Eugenics Congress in 1932, an opportunity was given for visitors to record on a voting machine what taste, if any, they got from paper impregnated with a medium concentration of PTC Of the 6,377 who voted, 1,296, or 20 3 per cent, were non tasters and 5,081, or 79 7 per cent, were tasters The latter reported their tastes as follows

Bitter	Sour	Sweet	Salty	Other tastes
4,168	346	134	309	124
(65 4 per cent)	(5 4 per cent)	(2 1 per cent)	(4 8 per cent)	(1 9 per cent)

Among the other tastes reported were bitter almonds, camphor and sulfur, which are really odors

Some of those who attributed sour, sweet or salty to PTC were tested and found able to recognize these tastes as well as bitter in test solutions of other substances A considerable number of people, however, can not discriminate between some of the primary tastes Many people, for example, get the same sensation from what most of us call bitter and sour

It has been shown by others, as well as by the writer, that differences in ability to taste PTC are innate and hereditary There is no reason to believe that differences in ability to taste other substances are not also innate and hereditary, although PTC is the only one so far tested genetically

Following the soup, the tables were supplied with "tabloids" of the rare sugar mannose which had been prepared through the kindness of Dr C S Leonard, director of the Burroughs Wellcome Research Laboratories Each contained 5 mg mannose and 5 mg feculose, a tasteless starchy binder About 15 per cent found them entirely tasteless, 20 per cent found them sweet only, 10 per cent found them bitter only, while 55 per cent got both a sweet and a bitter taste To most of the latter the sweet comes first, but to some the bitter sensation preceded the sweet To some who were negative to PTC, it was a satisfaction to find they could taste both the sweet and the bitter in mannose, while some of the tasters of PTC failed to perceive one or both of the two tastes of this peculiar sugar There appears to be little correlation between a person's ability to taste two different kinds of bitter If the tabloids had been made to contain a different proportion of mannose and feculose, the proportion of tasters and non tasters would have been different as well as the proportion of those who tasted both the sweet and the bitter Perception of sweet and bitter in mannose depends upon individual thresholds, which may be different for these two sensations

Following the roast, instead of a taste test, which might have interfered with the succeeding test, there was interpolated, out of its logical sequence, an odor demonstration which will be discussed later

The salad consisted of Globe artichokes with mayonnaise dressing and was a taste test in itself After eating artichokes, 40 per cent found that water was unchanged in taste, while 60 per cent found water tasted different To most, this taste was sweet The taste reactions to water following artichokes were found to have no close relation to reactions to PTC or to mannose, which had been tried earlier in the meal No response has yet come to the request that was made for information as to what the chemical substance might be in artichokes which was responsible for the after taste of the water There is some evidence suggesting that certain methods of cooking may prevent the reaction Thus, Globe artichokes cooked with baking soda failed to elicit the reaction in a subject who is regularly positive, and negative reactions have been obtained from the preserved hearts of artichokes which are sold in bottles

During the remainder of the dinner and after the coffee, demonstrations were given of differences in reactions to odors Flowers of a cultivated variety of snapdragons (Antirrhinum) and of the Golden Gleam Nasturtium had been supplied as individual table decorations and provided objects more attractive to the eyes than they were to the noses of some of the diners Each flower was graded according to the strength of its odor as odor absent, weak, medium or strong and in regard to the feelings which it aroused as pleasant, indifferent or unpleasant About a quarter could detect no odor in the snapdragon and the rest found the odor weak or of only medium strength in contrast to the nasturtiums, which to most were strong or of medium strength, with only a few calling the odor weak Connected probably with this difference in the strength of odor in the two flowers, a higher proportion of the people considered the odor of the snapdragon pleasant than the proportion which found the nasturtium fragrant and a larger number considered the odor of the latter disagreeable than found the snapdragon to be unpleasant Certain other flowers[1] with which the writer has experimented appear better adapted to showing differences in smell reactions, but almost any flower with not too strong an odor will disclose some who can not smell it if enough people are tested A person who is unable to detect fragrance in one kind of flower may be keen in detecting fragrance in other flowers

Some peculiar reactions to certain natural odors have been reported Thus, several persons have told the writer they could not smell the odor of skunk even when it appeared strong to others, in one case after running over the source of the odor One person confessed that he really liked the odor when it was not too strong

Better than flowers and natural odors for testing people are known chemical substances, the concentration of which can be controlled at least roughly Folded pieces of filter paper are conveniently kept for several days in a sealed jar with a measured quantity of an alcoholic solution of the odorous substance and assembled in glassine envelopes shortly before the

[1] A F Blakeslee, *The Nat Hort Mag*, 11 211-212, July, 1932

demonstration. Vanillin and synthetic musk retain their odor in the paper for a considerable time and by adjusting the concentration a group can be separated as desired into a large or into a small proportion of smellers as contrasted with non-smellers. It is readily shown that smell is like taste in that people differ greatly in respect to the threshold at which they can first detect the odorous substance. Smell differs from taste, however, in several respects. There are only a few fairly well-defined categories into which people can classify their tastes, but for their olfactory sensations clear-cut classification seems to be impossible. Odors, in consequence, are generally described in terms of other odors and even of tastes, such as sweet and sour.

Moreover, people differ greatly in the way in which they described a given odor when they compare it with known odorous substances. This is well shown by cuminol, which is variously described by different people as smelling like citrus rind, caraway seeds, crushed bugs, roses, perspiration and other things fragrant or otherwise. This wide range of reactions to cuminol was kindly pointed out to us by Mr. H. S. Redgrove, but caprillic alcohol has somewhat the same odor and we have found it to elicit similar reactions of nearly as wide a range. Many have difficulty in recognizing what kind of perfume they are smelling unless they see the name on the bottle or the flower from which the odor comes. Both cuminol and caprillic alcohol are good reagents also with which to show the differences between people in regard to their emotional response to an odor. The concentration of cuminol on the papers brought to Berkeley was such that about as many found the odor pleasant as those who found it unpleasant. By making the odor stronger or weaker in other demonstrations we have found a larger or smaller proportion who had unpleasant reactions. It was obvious that concentration of odor has much to do with our likes or dislikes. Strong odors are generally unpleasant but, since people differ in thresholds, what is strong to one is weak to another.

Odors are also tied up with associations that make them pleasant or unpleasant, apart from their strength. Associations, conscious or unconscious, probably are the most important factors in making an odor agreeable or disagreeable, as can be realized by one's reactions to odors that are purely personal.

Smell differs from taste again in that the olfactory powers appear dulled with age, and cases are not rare in which the sense of smell has become entirely lost. Several parents have told the writer that certain of their children when young, by smelling a handkerchief they had picked up, were able to tell to which member of the family it belonged, but that this ability had been lost after they had grown up. The writer knows a child personally who surprised his family by recognizing clothes as belonging to a playmate after they had been mixed up in the wash returned from the laundry, but his sense of smell is not unusually keen now in his early twenties. The organs of smell may be temporarily put out of commission by environmental factors, such as a cold in the head or olfactory fatigue. The taste reactions are probably more constant for a given individual, although recent studies indicate that taste acuity may change considerably from one time to another.[2]

Flavors are really odors and to be perceived must be volatile. Unlike the four primary tastes—bitter, sour, sweet and salt, flavors are supposed not to be perceived when the nose is closed. The diners were asked to hold the nose while putting into the mouth a pastille of Bittra chocolate and to note all the sensations resulting. To most, no taste of chocolate (really an odor) was evident until the nose was opened but, as is always the case in such demonstrations, a considerable number reported the chocolate flavor while the nose was still closed. Those with a low threshold (*i.e.*, acute tasters) for bitterness in chocolate could detect the bitter taste in the confection that was not evident to others. A further difference between people was disclosed by the fact that a considerable number could detect no sweetness while the nose was closed, but the sweetness was evident as soon as the nose was opened. The reason for this unexpected result is not yet clear. It has been of regular occurrence whenever groups of people have been tested with confections in this way. "Lifesaver" tablets are convenient objects with which to show different reactions to tastes, flavors and other sensations connected with eating. Sour as well as sweet can be differentiated as tastes in distinction to the flavor in orange or lemon lozenges, for example. Peppermint and wintergreen in addition to the flavor produce a sensation which is variously described as hot or cooling. This can be shown to be neither an odor nor a taste, if we limit this last term to the four primary tastes—bitter, sour, sweet and salt—as most authors believe we should. Hot tamales of our southern neighbors owe their hotness to red pepper, the heat of which is neither smelled nor tasted, properly speaking. Although we purchase pure tastes in the form of sugar, table salt, the acetic acid of vinegar and the bitter constituents of beer and some other drinks, most of the money spent to satisfy our appetites is expended for odors in the form of flavors and for other mouth sensations not properly classified in the category of taste.

Those who had seen how differently from themselves

[2] T. N. Salmon and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 21: 78–83, Feb., 1935; A. F. Blakeslee and T. N. Salmon, *Proc. Nat. Acad. Sci.*, 21: 84–90, Feb., 1935.

others had reacted to the tests were perhaps a trifle more inclined to be tolerant of the opinions of other people. From the differences in taste and smell which they had seen in respect to a relatively few substances they could believe the statement that no two people are exactly alike in their sensory reactions and probably never have been. Training and other environmental factors do have an influence on human perceptions and behavior, but it is safe to say that judgments of drinkers regarding the taste of beer and judgments of the Supreme Court regarding issues of law can not help differing because men are born different.

SCIENTIFIC EVENTS

THE NORWICH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE annual meeting of the British Association for the Advancement of Science will be held at Norwich from September 4 to 11, under the presidency of Professor W. W. Watts. The only previous meeting of the British Association in the city of Norwich was in 1868 under the presidency of Dr. Joseph D. Hooker.

The inaugural general meeting will take place at 8:30 P. M. on Wednesday evening, September 4, when Professor Watts will deliver the presidential address, on "Form, Drift and Rhythm of the Continents."

The presidents of the sections and titles of their addresses are as follows:

Section A (Mathematical and Physical Sciences): Dr. F. W. Aston, "The Story of Isotopes."

Section B (Chemistry): Professor W. N. Haworth, subject to be announced.

Section C (Geology): Professor G. Hickling, "Some Aspects of Coal Research."

Section D (Zoology): Professor F. Balfour Browne, "The Species Problem."

Section E (Geography): Professor F. Debenham, "Some Aspects of the Polar Regions."

Section F (Economic Science and Statistics): Professor J. G. Smith, "Economic Nationalism and Foreign Trade."

Section G (Engineering): J. S. Wilson, "Stability of Structures."

Section H (Anthropology): Sir Arthur Smith Woodward, "Recent Progress in the Study of Early Man."

Section I (Physiology): Professor P. T. Herring, "The Pituitary Body and the Diencephalon."

Section J (Psychology): Dr. Ll. Wynn Jones, "Personality and Age."

Section K (Botany): F. T. Brooks, "Some Aspects of Plant Pathology."

Section L (Education): Dr. A. W. Pickard-Cambridge, "Education and Freedom."

Section M (Agriculture): Dr. J. A. Venn, "The Financial and Economic Results of State Control in Agriculture."

An evening discourse will be delivered on September 6, by Dr. S. J. Davies, dealing with "Diesel Engines in Relation to Coastwise Shipping." A second evening discourse will be delivered on September 10, by Dr. C. S. Myers, on "The Help of Psychology in the Choice of a Career."

The Lord Mayor of Norwich, P. W. Jewson, and the Lady Mayoress will give a reception in the Castle Museum on the evening of September 5, and a garden party at Crown Point will be given during the week by H. M. Lieutenant for Norfolk, Russell J. Colman, and Mrs. Colman.

September 7 has been reserved for general excursions to places of interest, schools and industrial firms in the neighborhood of Norwich. Preceding the meeting a geological excursion of four days' duration under the direction of Professor P. G. H. Boswell is being arranged to examine the coastal and inland sections in Norfolk from Hunstanton (Lower Greensand, Red Chalk, Lower Chalk) *via* Morston (purple boulder clay and raised beach) and Weybourne (Weybourne Crag) to Cromer and Bacton (Cromer Forest Beds, Scandinavian Drift and Chalky Boulder Clay).

The societies in correspondence with the association consist of (*a*) Affiliated Societies undertaking local scientific investigations and publishing the results; and (*b*) Associated Societies of at least three years' standing, and not fewer than fifty members, formed for the purpose of encouraging the study of science.

Delegates of the Corresponding Societies will meet on September 5 and 10 to discuss matters of common interest to the societies and the association. The presidential address, by Professor P. G. H. Boswell, will deal with town and country planning.

Future annual meetings will be held as follows: 1936, in Blackpool; 1937, in Nottingham; 1938, in Cambridge.

INTERNATIONAL BIOLOGICAL CONGRESSES

UNDER authorization of the national entomological societies and of Section F of the American Association for the Advancement of Science, arrangements have been made with certain steamship companies for the transportation of those going from America to the Entomological and Zoological Congresses. These arrangements and certain European tours in advance of the congresses are also open to those attending the other congresses, or their friends, or to the university public in general. The European excursions will be as follows:

A. Mediterranean, Adriatic and Black Sea Cruise, followed by a tour of Morocco, Spain and Portugal June 29 to October 3 $675, tourist class, and up

B Kayak trip on German rivers, followed by tour of Morocco, Spain and Portugal, June 29 to October 3 $575 third class $700, tourist class

C Paris to Rhine, the Black Forest, the Alps, Italy and Madrid, August 13 to September 21 Considerably less than $500, tourist class

Particulars in regard to steamboat and railroad rates for the congresses on physiology, botany, entomology, zoology and neurology are given below Reservations and further details can be obtained for Excursion C Professor P W Claassen, Cornell University, Ithaca, N Y For other excursions and steamship bookings Professor J C Bradley, 322 E State St, Ithaca, N Y

The Fifteenth International Physiological Congress, Leningrad and Moscow, August 8–18 Arrangements within Russia, including numerous excursions, are in the charge of Intourist, Inc It should be noted that passengers can be booked through to Leningrad and from Moscow for any Atlantic steamer and port (tourist, special or third class) for very much less than it would cost to book to the terminus of the steamer and then to buy rail tickets to and from Russia

The Sixth International Botanical Congress, Amsterdam, September 2–7 The official steamer eastbound is the *SS Statendam*, sailing on August 13 No particular steamer has been set aside for return Botanists wishing to return with the entomological group may join the *Rex* at Nice (Villefranche) on September 13 The rates are the same as from Gibraltar

The Sixth International Congress of Entomology, Madrid, September 6–12 Several interesting excursions are announced Those going directly to the congress will sail on the *SS Roma* on August 24, or the *SS Rex* on August 31, according to the date finally fixed for the congress The return will be on the *Rex* on September 16

The Twelfth International Zoological Congress, Lisbon, September 14–21 The organizing committee announces reduction in French and Portuguese rail rates and in hotel rates They also announce attractive excursions Those going directly to and from this congress will sail on the *SS Rex* on August 31, returning on *SS Conte di Savoia*, sailing on September 27 from Gibraltar

The Second International Neurological Congress, London, July 29 to August 2

THE HAYDEN PLANETARIUM OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE Hayden Planetarium of the American Museum of Natural History is fast assuming its final form The exterior of the square brick building at the corner of 81st Street and Central Park West is practically finished The copper dome—the outer dome—is entirely completed, and has already been so treated that it has taken on its permanent greenish color The Park Department of the City of New York is making extensive preparations to beautify the grounds in which the planetarium stands, as well as to provide adjacent parking space for about one hundred cars. New trees and shrubbery are being planted, and a semicircular driveway approach from 81st Street constructed past the entrance to the building

Work is also progressing very rapidly on the interior of the building The circular chamber on the first floor, which is to house the Copernican Planetarium, will soon be ready for the instrument which is now receiving the final touches in the workshop of J W Fecker in Pittsburgh This planetarium, which shows the solar system as it would appear if the sun and earth and the other planets were viewed from a distance off in space, is to be installed on the ceiling of this first floor room The sun is represented by a lighted globe and the planets and satellites by spheres which revolve on tracks around the sun It is planned, eventually, to place around the walls of this hall various astronomical murals

The second floor hall, with its great 75 foot dome, the very top of which is some forty seven feet from the floor, was built for the Zeiss Projection Planetarium This planetarium shows the various aspects and phenomena of the sky as they appear to man as he stands and gazes from his earth out into space The instrument, itself, which looks like a great dumb bell pivoting at the center, is in reality an aggregation of over one hundred stereopticon machines which project on the dome overhead the semblance of the night sky This dome is of perforated stainless steel, a type of material which has proved very satisfactory in improving acoustical properties, which are always a problem in a round room At the time of writing, this dome is completely finished with the exception of its final coating of white paint

The silhouette of the New York City sky line which is cut out of the bottom row of the stainless steel plates (about ten feet above the floor), was copied from photographs taken in Central Park of the entire city sky line as it is seen from that point. Back of this cut out silhouette the wall is painted black, so the stars, when they reach the buildings, disappear naturally into the blackness, and likewise into the blackness of the oblique baffles at the side and just below the silhouette This does away with the embarrassing difficulty of having the stars slide down over the fronts of the buildings in the silhouette and down the sidewalls, as they would do if these were of solid material instead of baffles.

It is hoped that the planetarium will be open to the public by the middle of September, although it is possible that later this date may have to be moved to

early October By the middle of June the second floor hall can probably be turned over to the Carl Zeiss Company to begin the assembling and installation of the projection instrument which is now crated and in storage in a New York City warehouse This installation requires at least two months, for it is a delicate job done by special engineers from the Zeiss works in Jena

One of the most-used entrances to the planetarium will be, no doubt, through the Roosevelt Memorial, that beautiful and stately building which is to form the central unit of the American Museum of Natural History, on Central Park West Although the Roosevelt Memorial may not be open to the public until November, doorways are now being cut through its walls into the Planetarium, and as soon as both buildings are open, the use of this entrance into the planetarium will greatly facilitate the handling of crowds

The Planetarium building itself was made possible by a loan of $650,000 from the Reconstruction Finance Corporation, while the two planetarium instruments were given through the generosity of Charles Hayden, for whom the planetarium is named

CLYDE FISHER,
Curator of Astronomy

HONORS CONFERRED BY THE FRANKLIN INSTITUTE

AT the Medal Day Exercises of The Franklin Institute of the State of Pennsylvania, held in the Hall of the institute, the Parkway at Twentieth Street in Philadelphia, on the afternoon of Wednesday, May 15, seventeen honors which had been awarded during the institute year were presented to their recipients or representatives of them The medalists were drawn from England as well as from the United States The awards were as follows

Certificate of Merit

To George Kelley, of New York City, New York, "in consideration of the invention of an apparatus for the removing of the dust produced in the drilling of rock and the resulting lessening of the silicosis hazard."

The Edward Longstreth Medals

Founded in 1890 by Edward Longstreth, Philadelphia. To Edmond Bruce, of the Bell Telephone Laboratories of Red Bank N J, "in consideration of his design and development of antennae for short wave communication combining superior efficiency, high directivity, simple construction and effectiveness over a broad range of frequencies " To Howard D Colman and Burt A Peterson, of Rockford, Ill, jointly, "in consideration of the signal advance in the art made by the Barber Colman Automatic Spooler and of the general excellence of its design." To Peter Davey, of New York City, "in consideration of the successful and useful combination of well known principles embodied in the vibroscope and vibrometer and especially of their combination in a portable balancing device " To Karl B McEachron, of the General Electric Company, Pittsfield, Mass, "in consideration of his careful conduct of a series of closely controlled investigations extending over a period of six years which resulted in the successful development of a process for manufacturing thyrite "

The John Price Wetherill Medals

Founded in 1925 by the family of the late John Price Wetherill To Dr Francis F Lucas, of the Bell Telephone Laboratories, in consideration of his development of a technique of microscopy and photomicrography by virtue of which objectives of the highest numerical aperture yet developed and visible light and ultra violet light have been brought to their full theoretical resolving power, and by the use of which photomicrographs of metallurgical and biological specimens superior to any heretofore made are now being produced under his direction " To Robert E Naumburg of New York City, "in recognition of an invention which embodies a meritorious utilization of several well known mechanical and physical principles to produce an apparatus original in its accomplishments and of unquestioned benefit to humanity " To W H Shortt, of Exeter and F Hope Jones, of London, jointly, "in consideration of their respective contributions to the invention, development and production of a free pendulum type of clock of remarkable precision which is now used in standard time control in Great Britain and the United States " To Dr James E Shrader, of the Drexel Institute Philadelphia, "in consideration of the design and construction of a portable and easily operated instrument for the investigation of vibrations, which affords simultaneous records of the vibrations in three mutually rectangular directions and in which the inventor displayed much ingenuity " To Dr Louis Bryant Tuckerman of the National Bureau of Standards, "in consideration of the fundamental improvements which he has introduced into the optical lever, making it an instrument of hitherto unrealized precision and of his ingenious application of this lever to a strain gauge." To Henry Ellis Warren, of Ashland, Mass, "in consideration of his invention of the telechron motor—a small, limited power, self starting, synchronous motor having strong starting torque and synchronous torque characteristics."

The Walton Clark Medal

Established in 1926 by the United Gas Improvement Company of Philadelphia To Frederick Joseph West, of Manchester, England, "in consideration of his outstanding service to the gas industry in the sphere of improved scientific development of gas works practise and technique and practical gas research as applied particularly to the carbonization of coal in vertical retorts, and for his work in the training and education of engineers and his success in promoting amicable relationships between employer and employed, all of which have been of substantial value to the manufactured gas industry "

The Louis Edward Levy Medal

Founded in 1923 by the family of Louis E Levy of Philadelphia. To Dr H L. Hazen, of the Massachusetts Institute of Technology "for his two papers published in the September, 1934 issue of the *Journal* of the Institute and the November, 1934, issue entitled, respectively, Theory of Servo Mechanisms and Design and Test of a High Performance Servo Mechanism'"

The Franklin Medals

Founded in 1914 by Samuel Insull, Esq, of Chicago, Ill To Dr Albert Einstein, of the Institute for Advanced Study, Princeton, N J, "in recognition of his contributions of fundamental importance to theoretical physics, especially his work on relativity and the photoelectric effect" To Sir John Ambrose Fleming emeritus professor of the University of London, London, Eng, "in recognition of his many contributions to the improvement of the art of communication, and especially the invention of the thermionic valve which bears his name" Sir Ambrose was unable to come to America to receive his medal in person He was represented by the British Consul General at Philadelphia

In the evening a subscription dinner was held in honor of the medalists at the Bellevue Stratford Hotel

SEMI-CENTENNIAL OF THE AWARD OF THE FIRST ELECTRICAL ENGINEERING DEGREE IN AMERICA

The Massachusetts Institute of Technology on August 31, 1882, announced its pioneer course, and on June 2, 1885, awarded the first electrical-engineering degree in America The event will be celebrated at Cambridge on Alumni Day, June 3, by a Semi Centennial Symposium in which electrical engineering education in the United States during the past fifty years will be reviewed with particular reference to the influence that the Massachusetts Institute of Technology has had on its development

The principal speakers will be Dr F B Jewett, '03, president of the Bell Telephone Laboratories, Inc, Dr A A Potter, '03, dean of engineering at Purdue University, and Dr Vannevar Bush, '16, vice-president and dean of engineering at the Massachusetts Institute of Technology Professor D C Jackson, head of the department of electrical engineering, will preside

Following the symposium, a testimonial luncheon will be held in the Walker Memorial for Professor Jackson, who is retiring this year after directing the electrical-engineering division for twenty-eight years The speakers at the luncheon will include Herbert G Pratt, '85, president of the Samson Cordage Works, C A Stone, '88, chairman of the board, Stone and Webster, Inc, Gerard Swope, '95, president of the General Electric Company, Professor W S Rodman, '09, dean of engineering at the University of Virginia, Professor O G C Dahl, '21, representing the electrical engineering faculty at the institute, and Dr K T Compton, president, and E L Moreland, '07, who will succeed Professor Jackson as head of the department of electrical engineering Professor Jackson will respond, and Alexander Macomber, '07, consulting engineer and public utility executive, will preside

After the luncheon Professor Jackson, attended by the electrical engineering faculty, will hold a reception for the guests In the electrical engineering laboratories special demonstrations will be made of calculating machines, electrical communication, sound measurement, modern illumination, developments in electronics, stroboscopic measurement, insulation research, electro physiological research and super high voltage engineering A statistical and historical exhibit will illustrate the development of electrical engineering education at the institute

RECENT DEATHS

Dr Charles Horace Clapp president of the State University of Montana, formerly of the Geological Survey of Canada and of the U S Geological Survey, died on May 9 at the age of fifty two years

Dr. Alfred E Burton, who joined the faculty of the Massachusetts Institute of Technology as instructor of topographical engineering in 1882, becoming professor emeritus in 1922, died on May 11 at the age of seventy-eight years Dr Burton served the institute as dean for a period of twenty years

The death is announced of H B Baker, lately professor of general chemistry in the Imperial College of Science and Technology, London, on April 27 at the age of seventy three years

Professor Hector Munro MacDonald, since 1904 professor of mathematics at the University of Aberdeen, died on May 16 He was a fellow of the Royal Society, in whose proceedings his contributions to the mathematical theory of radio were mainly published He received the society's Royal Medal in 1916 He was also a fellow of the Royal Astronomical Association and president of the London Mathematical Society

Herbert Henry Thomas, petrographer to the British Geological Survey, died on May 12 He was a former secretary and president of the Geological Society and a former president of Section C of the British Association In 1925 he won the Murchison Medal of the Geological Society He was fifty nine years old.

SCIENTIFIC NOTES AND NEWS

THE Langley Medal for aerodromics of the Smithsonian Institution was presented on May 21 to Dr Joseph S Ames, retiring president of the Johns Hopkins University, chairman of the National Advisory Committee for Aeronautics. The presentation was made by Chief Justice Charles E Hughes chancellor of the institution, in accordance with a vote of the Board of Regents at their annual meeting in January The award, as stated in the resolution accompanying the medal, was "in recognition of the surpassing improvement of the performance, efficiency and safety of American aircraft resulting from the fundamental scientific researches conducted by the National Advisory Committee for Aeronautics under the leadership of Dr Ames"

THE Chalmers Medal of the Royal Society of Tropical Medicine and Hygiene has been awarded to Professor William H Taliaferro, head of the department of hygiene and bacteriology of the University of Chicago, "in recognition of his valuable contributions to knowledge of the subject of animal immunity" The Chalmers Medal is granted every two years to a man under forty five years of age who has "contributed signally" to research in tropical medicine

THE American Section of the Society of Chemical Industry announces that the Chemical Industry Medal for 1935 has been awarded to Dr Edward R Weidlein, director of the Mellon Institute of Industrial Research at Pittsburgh, Pa This award is made annually to a person who has made a valuable application of chemical research to industry, primary consideration being given to applications in the public interest Presentation of the medal will be made at a meeting of the Society of Chemical Industry in the fall

THE Schoellkopf Medal for 1935 was presented on May 7 at the meeting of the Western New York Section of the American Chemical Society to F A. Lidbury, president and general manager of the Oldbury Electro Chemical Co, Niagara Falls, N Y, for his "contributions to the science of electrochemistry and his many-sided activities, both as chemist and executive, in the service of the American chemical industry"

THE Leslie Dana Gold Medal of the National Society for the Prevention of Blindness was presented to Dr William H. Wilder, emeritus professor of ophthalmology, Rush Medical College, Chicago, at ceremonies in St Louis on May 18 Dr Wilder was selected for the award, in recognition of his work in the conservation of vision, by the national society in cooperation with the St Louis society

A TESTIMONIAL dinner was given recently by former students and members of his department to Dr John E Ostrander, retiring head of the department of mathematics of the Massachusetts State College He was presented with a bound volume of letters from students whom he had taught during the thirty seven years of his professorship Dr Clarence E Gordon, head of the division of physical and biological sciences, acted as toastmaster Among those who spoke were Dr Hugh P Baker, president of the college, Philip F Whitmore, of Sunderland, member of the Board of Trustees, Dixon R Fox, president of Union College, of which Dr Ostrander is an alumnus, Dr Joseph B Lindsey, emeritus professor of chemistry, Professor Thomas Esty, of the department of mathematics, Amherst College, Dr Sidney B Haskell, president of Synthetic Nitrogen Products Company of New York, until 1927 director of the Massachusetts Experiment Station, and Professor Frank C Moore, associate professor of mathematics

DR. CHARLES EDWARD COATES, dean of the College of Pure and Applied Science, received the degree of doctor of laws at the diamond jubilee celebration of the Louisiana State University The degree was awarded "in recognition of long years of distinguished services in teaching and research loyal devotion to the university and to the cause of science, faithful efforts to advance the cultural and industrial interests of southern life, contributions through Louisiana State University to the world community, teacher scholar, scientist, friend of learning and of men"

DR. FRANCIS E LLOYD, professor of botany emeritus at McGill University, has been elected an honorary fellow of the Botanical Society of Edinburgh

DR. A C SEWARD, professor of botany at the University of Cambridge, has been elected a member of the Norwegian Academy of Science and Letters

DR. EDWIN G CONKLIN, professor emeritus of biology, was elected president of the Princeton chapter of Sigma Xi, at the annual meeting of the chapter held on May 17 The principal address was made by Professor Henry Norris Russell, retiring president of the society, on "The Origin of the Planets—an Unsolved Mystery" Other officers for next year will be Professor Luther P Eisenhart, *vice president*, Professor Louis A Turner, *secretary*, Professor Erling Dorf, *treasurer*, and Professor George E Beggs, *committeeman*

THE Central New York and Central Pennsylvania branches of the Society of American Bacteriologists will hold a combined meeting at Cornell University,

on Saturday afternoon and evening, May 25 Dr Karl Meyer, president of the Society of American Bacteriologists, will be the guest speaker

DR JAMES F COUCH, chemist of the Bureau of Animal Industry of the Department of Agriculture and professor of historical science at the National University, has been elected president of the Chemical Society of Washington, D C

VINCENT P GIANELLA has been advanced from associate professor to full professor and head of the department of geology in the Mackay School of Mines of the University of Nevada Dr Harry E Wheeler has been appointed instructor in the department, succeeding Dr Thomas P Thayer

AT Harvard University, Professor Frederick L Hisaw, of the University of Wisconsin has been appointed professor of zoology, and Dr Harry L Fevold, who has been associated with him at Wisconsin, has been appointed assistant professor of biological chemistry Dr Abraham Myerson, of Boston, has been appointed clinical professor of psychiatry

DR EARL H HERRICK head of the department of biology of the Louisiana State Normal College, has been appointed associate professor of zoology and agricultural experiment station mammalogist in the Kansas State College, to succeed the late Dr George E Johnson

DR FREDERICK L HOFFMAN, Philadelphia consulting statistician of the Prudential Life Insurance Company since 1894, retired from active duty on May 1, at the age of seventy years

DR HOWARD B LEWIS director of the College of Pharmacy of the University of Michigan and professor of physiological chemistry in the Medical School, has been elected a member of the National Board of Medical Examiners of the United States to succeed the late Professor Otto Folin, of Harvard University

DR GREGORY D MAHAR a member of the staff of the Syracuse Department of Health since 1923, has been appointed health commissioner of the city, to succeed Dr George C Ruhland, who recently became health commissioner of the District of Columbia.

DR. WALLACE RUDDELL AYKROYD has been appointed by the Governing Body of the Indian Research Fund Association to the post of director of nutritional research under that association

SIR HENRY LYONS has been appointed chairman of the Advisory Council of the Science Museum, London He succeeds Sir Richard Glazebrook, formerly chairman, who has resigned

DR. GEORGE A HULETT, professor of physical chemistry at Princeton University, was the representative of the American Chemical Society to the fifth National Meeting of Pure and Applied Chemistry, held in Sardinia from May 1 to 7 Dr William F Zimmerli, head of the foreign relations department of E I du Pont de Nemours and Company, will represent the society at the fifteenth Congress of Industrial Chemistry, which will be held in Brussels, from September 22 to 28

DR. WILLIAM AUSTIN CANNON, of the department of botany, of Stanford University, is spending the year in Europe He will visit the leading botanical gardens and laboratories and will be a delegate from Stanford University to the Botanical Congress to be held at Amsterdam in September

HARRY C RAVEN, associate curator of comparative and human anatomy at the American Museum of Natural History, has returned from an expedition in Malaya

AN expedition for the Academy of Natural Sciences of Philadelphia, led by R R N Carpenter, a trustee of the academy, will leave Philadelphia early in June for a six weeks' cruise on the yacht *Westward*, among the islands of southern Alaska, with the object of studying the animals and birds of that region

DR. IRVING LANGMUIR, director of the Research Laboratory of the General Electric Company, gave a lecture at The Johns Hopkins University on "New Work on Monatomic and Multimolecular Films," on May 10 under the A R L Dohme lectureship in chemistry

DR. HUGH M SMITH, who recently returned to the United States after having served for ten years as biological adviser to the Siamese Government, gave a lecture on May 4 before the Washington Biological Society on Siamese zoology Dr Maurice C Hall, of the Bureau of Animal Industry, spoke at the same meeting on "The Application of Military Principles to the Control of Animal Parasites"

PROFESSOR L B AREY, of the Northwestern University Medical School, delivered the annual William Snow Miller lecture at the University of Wisconsin on May 2 The title of the address was "Factors that Influence the Course of Wound Healing"

DR DONALD H MENZEL, of the Harvard Observatory, spoke before the Richmond (Virginia) Section of the American Chemical Society on April 19 on the subject "Cosmic Chemistry", on April 22 at Goucher College in Baltimore, and on April 24 at Foxcroft School, Middlebury, Va, he lectured on "Exploring the Universe" At the Leander McCormick Observatory on April 25 he gave a colloquium on "Recent Advances in our Knowledge of the Solar Chromosphere"

THE forty third annual meeting of the American

Psychological Association will be held from September 4 to 7 at the University of Michigan

THE summer convention of the American Institute of Electrical Engineers will be held at Cornell University from June 24 to 28

THE first Congress on Undulant Fever in Men and Animals will be held at Avignon on June 11, 12 and 13 Further information can be obtained from the general secretary, Dr Joseph Julhen, Joyeuse, Ardèche, France

Industrial and Engineering Chemistry states that the tentative program of the fifteenth Congress of Industrial Chemistry, to be held in Brussels from September 22 to 28, has been announced Committees have been appointed and the congress organized in seven groups, which will have to do with organization of factory and laboratory, fuels, mineral and metallurgical industries, materials of construction, glass, ceramics, organic industries (dyes, pharmaceuticals, photographic products, resins, textiles, fats, tanning, etc), agricultural industries and industrial hygiene Two prizes are to be offered, of 5 000 Belgian francs each one for the best paper presented, and the second for the best paper presented by a Belgian author Full information regarding the congress may be obtained by addressing the Secretary, 132a Boulevard Maurice Lemonnier, Brussels, Belgium Papers must be received before July 15, and hotel reservations should be made before June 1.

THE sixth lecture in the Smith Reed Russell Series for this year at the George Washington University School of Medicine was given on May 14 Dr Karl F Meyer, of the George Williams Hooper Foundation, and professor of bacteriology at the University of California, was the guest speaker The subject of his lecture, which was illustrated with motion pictures, was "Selvatic Plague" In the afternoon the department of bacteriology held a tea and seminar, to which members of the faculty of the Medical School and guests from near by colleges were invited Dr Meyer spoke on 'Psittacosis," and again illustrated his talk with motion pictures

AT the annual meeting of the American Association of Pathologists and Bacteriologists held in New York, the following officers were elected *President,* Dr S B Wolbach, Boston, *Vice president,* Dr N C Foot, New York, *Treasurer,* Dr F B Mallory, Boston, *Secretary,* Dr H T Karsner, Cleveland, *Incoming Member of Council,* Dr C V Weller, Ann Arbor The symposium for the next annual meeting, to be held on April 9 and 10, 1936, in Boston, Mass, in joint session with the American Association of Immunologists, is on "Inflammation" Dr Arnold R Rich, of Baltimore was selected as referee for this symposium The gold headed cane of the association was awarded to Dr Frank Burr Mallory, of Boston

THE eleventh annual meeting of the New York State Geological Association, held in Utica, N Y, on May 10 and 11, was attended by one hundred and seventy geologists and advanced students from New York New Jersey, Pennsylvania, Massachusetts and New Hampshire At the business meeting, which followed the banquet on the evening of May 10, the following officers were elected *President,* Professor H Ries, and *Secretary,* Dr J D Burfoot, both of Cornell University At the same meeting the association voted to accept the invitation extended by the Pennsylvania Association to meet with them in 1936, somewhere in the anthracite coal district, probably in the vicinity of Scranton, Pa

DISCUSSION

DIFFERENCE BETWEEN ARITHMETIC AND ALGEBRA

UNDER the term "algebra" in the recently published Webster's "New International Dictionary," second edition, 1935, it is stated that "The essential difference between arithmetic and algebra is that the former deals with concrete quantities, while the latter deals with symbols whose values may be any out of a given number field" Those who are at first inclined to adopt the explanations which appear in such widely used and glowingly advertised works of reference as this dictionary will find it difficult to harmonize this quotation with the well-known fact that such numbers as 1, 2, 3, etc, are abstract, while such numbers as 2 men, 3 horses, etc, are concrete In particular, our common multiplication tables, which belong to the early part of arithmetic, relate entirely to abstract numbers The symbols which appear on blocks for children and represent natural numbers relate to just as abstract ideas as those which represent the numbers of a field

One of the chief objectives of pre Grecian mathematics was the study of the number field composed of the rational numbers The difference between algebra and arithmetic noted in the given quotation does not relate to the supposed fact that arithmetic deals with concrete quantities, while algebra deals with symbols representing numbers, but to the fact that algebra deals with symbols which may represent more general

numbers than those commonly used in elementary arithmetic It is a difference in generalization rather than a difference in abstraction As we advance in mathematical study we deal continually with more general ideas, but it is questionable whether we deal with relatively more abstract ideas It would be very difficult to prove that arithmetic deals with relatively more concrete quantities than algebra

It is well known that the terms arithmetic, algebra, geometry, etc, are somewhat vague and that there is no generally accepted line of division between the subjects represented by them Mathematics is commonly divided into pure and applied mathematics, but here there is also no commonly accepted line of division Concrete numbers are frequently considered in elementary algebra as well as in elementary arithmetic It should be noted that numbers are probably among the earliest abstract notions acquired by the human race and that one of the profoundest facts of mathematical history is the very early development of abstract mathematics It used to be said that the early Babylonian mathematics was mainly concerned with business arithmetic, but it has recently been emphasized by O Neugebauer and others that this early mathematics is mainly pure mathematics The first table in the well known Egyptian "Rhind Mathematical Papyrus" relates also entirely to abstract mathematics

A more definitely incorrect statement in this dictionary, which also relates to a subject of wide interest, appears under the term "determinant" It is here stated that the consistency or the inconsistency of a system of n linear equations, in n unknown quantities, depends on the non vanishing or the vanishing of the determinant of the system It is well known that the consistency or the inconsistency of a system of linear equations can not be determined by the study of the matrix of the system alone but requires also the consideration of the augmented matrix As the notation employed by G W Leibniz (1646–1716) differs so widely from the one which is now commonly employed to represent a determinant it is questionable whether it should be said that he discovered this subject, as is done here, notwithstanding the fact that this is also commonly done elsewhere Improvement in knowledge is more important than stability

G A MILLER

UNIVERSITY OF ILLINOIS

PHYSICAL INDETERMINACY AND PHILOSOPHICAL DETERMINISM

HEISENBERG has shown that if we use quantum-mechanical definitions of material particles and their interactions we admit a certain indeterminacy in experimental findings. It follows that, on this basis, it is impossible to prove or disprove the hypothesis that the physical universe is causally connected It is the purpose of this note to point out that, nevertheless, the "principle of indeterminacy" does not change the status of philosophical determinism for the worse, as some suppose, but rather for the better

The impossibility of proving strict causality by experiment was, in fact, just as apparent without resort to quantum mechanical arguments No careful physicist ever supposed that experiment could be so perfectly controlled as to furnish infinite precision This meant that experiment could never specify one state of a system so completely that another state (earlier or later) could be calculated precisely, even if the laws of physics were themselves immutable Otherwise put, no two states could be recorded so completely as to rule out the possibility that non-causal processes had occurred between them Heisenberg's result merely makes it clear that the spread between calculation and observation may be wide when the systems treated contain individually observable particles We may conclude that the postulation of a determinate (causal) universe is even farther from the possibility of physical upset than it was a few years ago

The philosophical implications of Heisenberg's principle would probably not have been misinterpreted if no attempt had been made to build a deterministic philosophy on experimental data alone, without conscious abstractions Such an attempt is interesting, and any degree of success in it is admirable We do not, however, expect a philosophy so handicapped to be of the very first quality, any more than we expect one armed golfers to win national championships, or caves, however neat, to replace more commodious dwellings The chief defect of such hand to mouth empiricism seems to be that it must build upon inconsistent experimental data and has no criterion within itself for resolving such contradictions as thereby arise Whether or not it uses quantum mechanical concepts it is foredoomed to chaos. Another difficulty arises in respect to the observer and his observing equipment Since it seems impossible to write down abbreviations for these in the simple way in which the numerical results of measurement appear in the attempted synthesis, there is a strong tendency to leave them out of the philosophic scheme altogether Incidentally, this probably precludes such a philosophy from arriving at any ethics whatever Perhaps its evasion from everything but meter sticks, springs and clocks explains its popularity among experiment addicts

L. W MCKEEHAN

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IS THE KILLARNEY GRANITE DIFFERENT IN AGE FROM THE ALGOMAN?

IN a recent address[1] entitled "Certain Aspects of Geologic Classifications and Correlations" Professor Rollin T Chamberlin makes two statements in his discussion of pre Cambrian correlations, which interest me as a rather sweeping expression of a theory which is important if true, but which is contradicted by some easily observable facts He says 'For a given province, such as the southern margin of the Canadian Shield, or at least important portions of it, the granite method of classifying rock systems is theoretically sound In this particular province the three granites of widely different ages, the Laurentian, Algoman and Killarney, are practically and potentially of great assistance in unravelling and delimiting the pre Cambrian systems" Again "From geologic evidence, the Laurentian, Algoman and Killarney granites appear to be so different in age that radioactive age determinations should distinguish between them"

The important matter in these statements is the recognition without question or doubt of the Killarney granite as distinct from the Algoman The proponents of this view regard the Killarney granite as of Keweenawan or post Keweenawan age Counter to this belief are the facts that a herd of olivine diabase dykes, presumably Keweenawan in age, cut the Killarney granite, and that north of Sault Ste Marie the lavas of the Keweenawan were poured out on the deeply eroded surface of the Killarney granite In view of these facts, set forth in my paper on Some Huronian Problems,"[2] it is somewhat surprising to see in text books and authoritative reviews like Chamberlin's dogmatic statements of the distinction between the Killarney and Algoman granite In so far as I have been able to discover in the field and in the literature of the subject the Killarney granite is the Algoman granite and it would be of interest if the "geologic evidence" as to their difference in age to which Professor Chamberlin refers might be set forth so that, if necessary, it might be checked up in the field

ANDREW C LAWSON

UNIVERSITY OF CALIFORNIA

[1] SCIENCE, February 22 and March 1, 1935

[2] *Bull* G S A, Vol 40, pp 361-384, 1929

GINKGO

RECENT news reports of monoecious growth in a century-old Ginkgo near Philadelphia can not be trusted direct Could such a phenomenon result from injury instead of earlier unknown grafting? Possibly the most extraordinary anomaly in Ginkgo is a growth of microsporangia directly on the foliage leaves, "usually near their bases" This appears to be a true recessiveness, recalling an older seed fern condition, precedent even to the Cordaites But evidence bearing on the morphologic as well as physiologic nature of sex in the seed plants is much wanted, and discussion must long fall short of final analysis We must long search and search through the rocks and the forests before the origin of the conifers and their relationship to the Cordaites and flowering cycads can be better discerned

In a few weeks (early May) the Ginkgo tree will blossom For any fruit of a seed plant—dicot, monocot or gymnosperm—begins as a 'blossom" or in an absolute sense a 'flower" Though not alone in common usage but by definition a 'flowering plant' means a higher seed plant which has advanced far toward a relative specialization of stem and foliar structure and which may bear round its fertile organs an inclosing husk of large and beautiful vari colored cataphylls, soon wilting away or sometimes fusing into the mature fruit Essentially however, the flower is an axial prolongation beyond the series of modified protecting foliar organs consisting in a subtending cyclic or spirally set series of microsporophylls or stamens, as followed by a terminal megasporophyll or series of such, but with the seeds always inclosed—the angiospermous condition Since, however, these seeds are inclosed within the megasporophylls which may bear many seeds or but one, and may be single or numerous and either cyclic or spirally set, flowers so readily assume an infinite variety of form, size and color The much modified foliar structures characteristically bear the nectaries haunted by insect and bird Where flowers are *unisexual* the implication is that they were once *bisexual*—in fairly recent geologic time, 'complete," "perfect," *hermaphrodite* While in the foliar fusion about the ovule and fruit there is seen a late reflex of the far simpler course of growth and fusion which at least as far back as Devonian times resulted in the large seeds of Pteridosperms and Cordaites, often with heavy bundle supplied integuments In this sense there is a fundamental analogy between seed and flower

Nevertheless, by some strange ratiocination the simpler forms of sex perfect flowers seem to have been long regarded by geologists as being little older than Cretaceous time And this deception long found its way into botany, despite the presence of the vestigial flowers of Gnetaleans, and obvious reasons for the failure of a fossil floral record in the Permian and older Mesozoic rocks Could the evidence in view be taken so superficially, accepted so directly? As apposed to the ordinary or higher types of flowers, the "cones" of the conifers differ mainly in a uniform unisexuality, with much fusion of parts and a high

degree of sclerotization and persistence, easily leading to fossilization Hence not alone the fossil record, but cone structures and old types must be far more closely scanned before it is assumed that cones are older than flowers Where then may sporophyll fusion and sex variation of an instructive form be first expected? Certainly in Ginkgo, perhaps even more primitive than the cycads, although the reverse view has been com monly held Both are in fact very primitive, considering the lengthening out of geologic time, but we see neither until after the organization of unisexual cones, and the cycads are much out of the easy observation range

Ginkgo, if not even recessive, is but little in advance of the Cordaites, and like them bears long-stalked seeds tending to run into bunches of three to five with much fusion, the normal number being two These bunches appear sparsely grouped on the somewhat persistent short or spur shoots. They are hence seen in an open or sub-inflorescent stage. The same is true of the staminate cones The conditions appear simpler than in conifers, and one of the first questions any one who has the opportunity to see Ginkgo in free fruiting may seek to answer is whether abnormal bisexual axes of any kind may ever occur as in conifers For while botanists have seemed even to prescribe the possibility of varied types of ancient flowers, a trend of change from separate to united sexes has not once been proven in all the range of seed plants Uniformly late separation of the sexes affords the first explanation of dioecism and usually also of monoecism Though what actually constitutes separateness of sex in a tree as compared with an animal is very little seen or under stood

G R. WIELAND

CARNEGIE INSTITUTION

SCIENTIFIC BOOKS

THE ICE AGE

The Changing World of the Ice Age By REGINALD A DALY Yale University Press Large octavo 271 + xxii pages, 149 figures $5 00

DARWIN, Dana, Davis, Daly—delvers in the deep and doughty disputants! In this book the century old problem of the genesis of coral reefs has its latest serious discussion, but not its last

The debated subject is an excellent example of changing theory with increase of knowledge When Charles Darwin brought the romantic topic of coral islands to public attention glacial science was yet unborn And when, toward half a century later, James D Dana revived scientific interest by his charming work on "Corals and Coral Islands" the fact that sea levels had been effectively changed, up and down, by the waxing and waning of the Pleistocene ice sheets was not clearly recognized But now pelagic science is involved with glaciology and the latter closely with geophysics

Darwin believed that the relation of coral growth and the building of barrier reefs and atolls implied submergence Deepening of the ocean basins with subsidence of the reef bearing floors was the simple and fully satisfactory explanation This was accepted and emphasized by Dana and recently amplified by Davis But they were in error in attributing the vertical oceanic-surface movement entirely, or even largely, to diastrophic movements of the earth s crust The im portant factor in the shifting of sea level in later or Pleistocene time was the transfer of water between sea and land by the production and the destruction of the continental ice sheets

The "Glacial Control" theory has for more than twenty years been championed by Professor Daly A student of glaciology and geophysics, he has traveled widely, studied the coral reefs at first hand, and with his active imagination and boldness in presentation of new views he has, by numerous writings, become the apostle of the later theory A word of exposition is desirable

The mass or volume of the two great existing ice caps, Antarctica and Greenland, is fairly estimated The melting of those ice fields and the return of the water to the sea would lift the ocean surface by about 164 feet During the recent Ice Age or Pleistocene vast areas of Europe and North America were deeply covered by solid water abstracted from the sea, and sufficient in volume to lower the ocean surface about 345 feet in careful estimate Taking into the account the involved diastrophic factor, the deformation of the globe by shifting of loads, Daly estimates an actual lowering of relative sea level of 90 meters or 295 feet The final melting of the ice caps, a few tens of thou sands of years ago, returned the borrowed water to the sea and lifted the ocean surface to practically its present position

Whatever were the changes in glaciation and deglaciation of the lands during the Ice Age it is now apparent that the volume of the ocean was correspondingly altered For clearer presentation of his theory the author groups the four generally recognized glacial stages into two major periods, with a long intermediate stage of deglaciation (interglacial) with

its warmer climate and higher ocean level And he assigns the initiation of the present coral reefs to the phase of low sea level during the second, or latest, major period of glaciation, and their construction during the waning of the ice caps and in post glacial time, while the sea level was rising The reefs built during the long deglaciation interval were destroyed during the low water stage of the subsequent glacial period The history so conceived is graphically given in his figure 130 Abundant illustrations, 135 dia grams and maps and 14 photographs, supplement the author's descriptions and enforce his views

This writing will provoke lively discussion and some friendly disagreement, especially relating to the age of the reefs and the origin and date of the level plat forms from which rise most of the wall like reefs And the degree of diastrophic effect in comparison with the glacial control may also be subject of debate But that the chief cause of changes in ocean level in later geologic time was the removal and the restoration of water by glacial processes appears to be well estab lished The author's "punching hypothesis" in expla nation of the crustal downthrow and the recoil, in stead of crustal flexure, will receive the attention of the geophysicists

The arrangement of matter in the volume and the style of presentation are related to the origin of the work, a series of Silliman Lectures at Yale University The matter relating to coral reefs is the closing part of the volume The larger part of the handsome and richly illustrated volume is the description of the Pleistocene ice fields of Europe and America, and their diastrophic effects in elastic and plastic flow distortion of the globe, all this leading to the coral reef problem

European glaciology is well covered, and the refer ences make a considerable bibliography of European glacial literature American glaciology is treated briefly and with reliance on older writings and official and 'authoritative" publications that are outdated Later and individual writings are overlooked or neglected Some omissions and errors in statement and maps are noted

Admittedly the writing leaves a thousand questions unanswered And with the author's fertility in hy pothesizing it suggests many more than it settles The great persistent interrogation in glacial science, the cause of Pleistocene glaciation, and especially of mul tiple ice stages, is untouched

The work is a stimulating contribution to earth science Pressing boldly into the area of the theoretic and speculative is more helpful to scientific progress than conservative standstill in acceptance of supposed fact and deference to authority

HERMAN L FAIRCHILD

UNIVERSITY OF ROCHESTER

VARIETIES OF HYDROGEN

Orthohydrogen, Parahydrogen, and Heavy Hydrogen By ADALBERT FARKAS 215 pages Cambridge University Press 1935 Price, $3 50

FOR the past few years the author of the present text has taken an active part in those rapid research developments which have transformed our knowledge of the element hydrogen Prior to the discovery of the heavy isotope, deuterium, the ordinary isotope of mass 1 had been shown, by theoretical reasoning and the brilliant experiments of Bonhoeffer, Harteck and Eucken, to exist in two molecular forms, ortho and para , determined by nuclear spin In the study of the chemical and physical properties of these molecules the author and his brother, L Farkas, were able col laborators of Bonhoeffer They studied, principally, kinetic properties of the two forms and the important rôle which paramagnetic substances may play in the interconversion of the molecules It was not surpris ing, therefore, that they rapidly reoriented their work when the complexity of the element was still further increased by the discovery of deuterium, employing their already acquired technique to the rapid solution of new problems which obviously arose

Dr A Farkas has placed all workers in the field under a debt of obligation to him by this monograph He has wisely chosen to outline both ortho and para hydrogen and heavy hydrogen because of the interde- pendence of the two fields The book contains an excellent summary of the physical chemistry of both hydrogen isotopes, equally effectively presented on the theoretical, practical, historical and bibliographical sides It is especially welcome to harassed workers in this feverishly active research field bringing into one volume, without exception so far as the reviewer can find, all the important contributions in the two spheres of work, up to the end of last year No one can read this book without realizing how a major discovery of this kind has consequences of importance over a wide area of scientific interest Fundamental problems con cerning energy states of molecules, nuclear structure and properties, spectra, reaction kinetics, isotope equilibria properties of solutions, mechanism in chemi- cal and biological processes all these have developed under the stimulus of the discoveries concerning the element hydrogen All are presented in this book in outline, in an orderly presentation, excellently readable in spite of the fact that the author is writing in, to him, a foreign language The book is indispensable to a wide variety of research men and to graduate stu dents in physics and physical chemistry It is the best approach that those scientists unfamiliar with the field can take to this new and fascinating development of the last six years

HUGH S TAYLOR

PRINCETON UNIVERSITY

STATE ACADEMIES

THE VIRGINIA ACADEMY OF SCIENCE

THE Virginia Academy of Science held its thirteenth annual meeting at the University of Richmond on May 2 and 3, 1935, with a registration of 503

The address at the open meeting Friday night was delivered by Alexander Wetmore, director of the U S National Museum, and 168 papers were read before the various sections

The annual prize of fifty dollars was awarded to Margaret Hess for a paper entitled ' Edema and General Atrophy in *Stenostomum oesophagium* Associated with Atrophy of the Protonephridium " Honorable mention was also accorded two other papers, one by Herbert Trotter, Jr, on the "Acceleration of Electrons to High Energies" and the other by Robert E Lutz and Fred S Palmer on ' The Structures of the Dimolecular Reduction Products of Dibenzoylethylene "

The research committee reported that grants in aid of research had been made during the year to J W Beams, W B Bell, Walter S Flory, H B Haag, C C Speidel and Edward Steidtmann

The officers elected for the coming year are as follows Ida Sitler, of Hollins College, becomes president, having been president-elect for the past year, H E Jordan, of the University of Virginia, president elect, E C L Miller, secretary treasurer, W H Keeble, of Randolph Macon College, councilor

The following officers of sections were elected

Astronomy Mathematics and Physics Mary J Cox, *chairman* R C Weaver, *secretary*

Biology Harry G Walker, *chairman*, Robert F Smart, *subchairman*, George W Chappelear, Jr, *secretary*

Education J L Manahan, *chairman* William L Prince, *secretary*

Chemistry R E Hussey *chairman* Roy S Cook, *secretary*

Geology Arthur Bevan, *chairman* William M McGill, *secretary*

Medical Sciences L E Starr *chairman*, H B Haag *secretary*

Psychology John M McGinnis *chairman* R C Somerville, *secretary*

At the close of the meeting the members of the geology section made a field trip to the topaz deposits in Amelia County, and the members of the biology section made a field trip to the Dismal Swamp

E C L MILLER,
Secretary

THE KANSAS ACADEMY OF SCIENCE

THE sixty seventh annual meeting of the Kansas Academy of Science was held at Lawrence, Kansas, from March 28 to 30 Professor Wm H Matthews, associate professor of physics, Kansas State Teachers College, Pittsburg, Kansas, presided, and Dr F C Gates, professor of botany, Kansas State College, served as secretary *pro-tem*, following the death of Dr George E Johnson Two hundred and eighty persons registered for the meetings There were 138 papers listed on the general and sectional programs, and four high schools gave demonstrations for the Junior Academy meeting, of which Dr Hazel Branch, of the University of Wichita has general charge

Sectional meetings were held for botany, zoology, medical science, chemistry, physics, psychology, entomology and the Junior Academy of Science Special tribute was paid to the late Dr Geo E Johnson, who served admirably as secretary since 1928, for his untiring efforts in behalf of the academy

The following addresses were special features of the meeting ' Glimpses of Germany," by Dr Ralph H Major, Kansas University, the presidential address by President Matthews on "Scientific Development and Investigation in Southeast Kansas," and "Tree Rings and Climate in Relation to Civilizations of the Southwest," by Dr A E Douglass, University of Arizona

The new officers elected are W J Baumgartner, *president*, L Oncley, *first vice president*, H H Hall, *second vice president*, Roger C Smith, *secretary*, H A Zinszer, *treasurer*, and F C Gates, *editor in chief* of the *Transactions* of the Kansas Academy of Science, whose term of office is three years W J Baumgartner was elected managing editor, and four associate editors were chosen They are C A Kelly, E O Deere, W W Floyd and Robert Taft

Chairmen of sections for 1935–1936 are L E Melchers, botany, C H Whitnah, chemistry, Kathleen Doering, entomology, H A Zinszer, physics, Bert Nash, psychology, James E Ackert, zoology, Hazel Branch, Junior Academy

The next annual meeting of the academy will be at the Kansas State Teachers College, Emporia, Kansas, in the spring of 1936

ROGER C SMITH,
Secretary

THE ARKANSAS ACADEMY OF SCIENCES, ARTS AND LETTERS

THE nineteenth annual meeting of the Arkansas Academy of Sciences, Arts and Letters was held at Henderson State Teachers College on Friday and Saturday, April 19 and 20 A very satisfactory representation of the membership was in attendance

On Friday evening, Professor H L. Minton, of the Arkansas State Teachers College of Conway, delivered an illustrated public address on 'The Tornado in the United States" On Saturday morning, a field trip was led by the state geologist, Dr George C Branner, to the Magnet Cove region

Officers elected for the ensuing year are as follows

President, Dr Hugh H Hyman, Henderson State Teachers College

Vice president, Professor W C Munn, Magnolia A and M College

Secretary Dr Lewis M Turner, University of Arkansas

Treasurer, Dr William R Horsfall, Monticello A and M College

Editor, Professor M Dennison, Henderson State Teachers College

The meeting next year will be at Monticello A and M College at Monticello

LEWIS M TURNER
Secretary

THE SOUTH DAKOTA ACADEMY OF SCIENCE

THE twentieth annual meeting of the South Dakota Academy of Science was held at Dakota Wesleyan University, Mitchell, South Dakota The attendance was unusually good Twenty nine papers were read by members The guest speaker was Dr J Howard Mathews, director of the course in chemistry at the University of Wisconsin, who spoke on the subject, The Use of Scientific Methods in the Detection of the Criminal"

The following officers were elected for the year 1935–36

President Wm H Powers South Dakota State College

First Vice president Gregg M Evans Yankton College

Second Vice president, Charles A Hunter University of South Dakota

Secretary treasurer A L Haines, University of South Dakota

A L HAINES
Secretary Treasurer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW MATERIAL FOR CORROSION PREPARATIONS

CORROSION preparations have yielded a great deal to our knowledge of the vascular system and to our knowledge of hollow organs The general technique and the limitations of the method are fairly well defined through many years of use To state the procedures briefly, a vessel or cavity is first filled with a solidifying mass and then the soft tissues, or both the soft tissue and bone, surrounding the mass are removed

A wide variety of solidifying masses have been used, waxy or fatty masses, alloys of low fusion point and masses prepared from guncotton These guncotton masses have found considerable favor because, in contrast to the metallic or wax masses, they may be injected cold Further, they are commonly less fragile than the wax masses and more complete than the metallic injections Originally introduced, at least into the literature, by Schiefferdecker[1] with the use of celloidin, the materials have been widely altered One common method, especially about hospital laboratories, is to make use of discarded x ray films as a base for preparing the mass In 1929, at the meeting of the American Association of Anatomists at Rochester, I demonstrated the use of the then recently introduced brush pyroxylin lacquers in the preparation of corrosions[2] The arteries of the white rat were used for demonstration Such fine details as the glomeruli of the kidney were beautifully shown The use of these commercial lacquers had the advantage that the pigments were already provided The disadvantage was that the solvent was not completely miscible with water, and as a result the mass would set slowly Recently these lacquers are no longer readily available, except through the automobile paint trade Various modifications have been tried, such as allowing these commercial lacquers to solidify in air and then suspending the solids in acetone The results are satisfactory, but the method is troublesome

The disadvantage of pyroxylin masses had always been due to the low percentage of concentration that it was possible to use This resulted in great shrinkage, particularly noticeable in the larger blood vessels The working rule of those who have pursued the corrosion method has always been to use wax or metal for studying larger structures and pyroxylin masses for studying the finer ramifications

This difficulty of shrinkage has been in part overcome, and a very satisfactory and easily working mass has been simply obtained by using one of the guncottons devised for the lacquer industry Use has already been made of low viscosity guncotton for microscopic technique[3] The feature of this material is that a solution containing approximately 50 per cent solids can

[1] Schiefferdecker, *Arch Anat Phys*, 1882, *Anat Abt*, p 201

[2] *Anat Rec*, 42 1, March 1929

[3] Saul Ruby, *Anat Rec*, 55 sup 74, 1933

be injected with a hand syringe The particular material used is 'dehydrated nitrocellulose, RS ½ second, viscosity 3 2," obtainable from Hercules Powder Company of Wilmington, Delaware The lower viscosity product, designated as RS 18–23 cps," has also been used, but the resulting preparations are too brittle for practical use The mass is made up as follows

nitrocellulose (Hercules RS ½ second)	1,000 grams
acetone (technical grade)	1,000 cc

Solution is accomplished in about twelve hours The mass may be colored with artists' oil pigments, which are conveniently put into the mass by working up with a small quantity of dioxan [4] English vermilion is particularly suitable as a color Acetone soluble stains are much easier to use Of the microscopic stains commonly available, toluidin blue gives a fairly satisfactory mass and fat soluble brilliant red gives a usable red These may be dissolved in the acetone before the mass is made or may be added in small quantity of solution subsequently

Maceration is accomplished as usual, either in concentrated technical hydrochloric acid or by this acid slightly diluted—one part water to five parts acid If it is desired to retain the bone, maceration in water at body temperature is carried out

The nitrocellulose as furnished contains 30 per cent alcohol With the repeated opening and closing of the container, some of the alcohol is lost, therefore, less quantity of the solid can be used Moreover, the mass above given represents the maximum viscosity which it has been found practical to inject Dilution should be practiced as required

With this material corrosions of the entire vascular system of the adult head have been made, both with and without the destruction of the bone [5] The material is sufficiently solid so that the corrosions may be handled dry with little fear of breakage However, they are being mounted in distilled water containing a small amount of formaldehyde

The costs of the materials used are at this time as follows

nitrocellulose—10 lb quantities		$4 08
acetone, technical—5 gal lots (30 lbs)	@	20½ lb
hydrochloric acid, technical—per carboy (115 lbs)	@	05½ lb

It requires about three days to macerate an adult head However, sometimes a fourth day with fresh acid is necessary Small specimens macerate over night

OSCAR V BATSON

GRADUATE SCHOOL OF MEDICINE
UNIVERSITY OF PENNSYLVANIA

[4] H W Mossman, *Anat Rec* 58 4, supplement, March, 1934

[5] A series of specimens so prepared was demonstrated at the College of Physicians, Philadelphia, Pa., January 16, 1935

SPECIAL ARTICLES

ABSORPTION OF NITRATES BY CORN IN THE DARK

THE effect of light and dark on plants is outside the writer's field of work, but some years ago he blundered into the experiment described below after a discussion with H A Allard concerning the "length of day" effect on plants The question arose whether plants normally absorb ions in the dark Curiosity on this point was not satisfied by texts on plant physiology, hence an experiment was performed with corn, using nitrate as the ion whose absorption was to be measured Several previous investigations show that a small amount of nitrate may be absorbed in the dark by plants kept continuously in the dark but these studies do not show what takes place in plants growing naturally In the following experiment the plants were grown under the normal condition of an alternation of light and darkness

Corn plants were grown in nutrient solutions with 7 hours of light and 17 hours of darkness each day Solutions were renewed or changed twice daily, at the beginning and end of the light period There were two check lots that received uniform treatment in both light and dark, one was supplied with a complete nutrient solution in both periods and the other with a solution lacking only nitrate A third lot received the nitrogen free solution in the light and the complete solution in the dark, while the fourth lot received the complete solution in the light and the nitrogen free in the dark The plants were grown in this way for 12 days and then analyzed Seedlings used in installing the experiment were previously grown for 7 days in a nitrogen free solution to produce a nitrogen deficiency Plants receiving nitrate at any period made a good growth and were normal in appearance Data on growth and nitrogen assimilation are given in Table 1 The experiment is doubtless entitled to more confidence than indicated by the probable errors of the average weights, since, when the experiment was installed, the seedlings were selected for uniformity by fours, one for each treatment, as a result, the 12 seedlings receiving the same treatment were quite variable in size

The data show quite plainly that corn grown under alternating periods of light and dark is capable of assimilating nitrate fully as well in darkness as in

TABLE 1

CORN GROWN WITH NITRATE SUPPLIED IN THE LIGHT AND IN THE DARK

When nitrate supplied	Average oven dry weight per two plants			Nitrogen in dry substance of		Nitrogen in two plants	Relative quantities nitrogen absorbed
	tops	roots	Ratio of roots / tops	tops	roots		
	gm	gm		Per cent	Per cent	gm	gm
None at any time	34 ± 02	20	59	1 64	1 19	0079	0
Both in light and in dark	62 ± 02	19	31	4 49	3 74	0348	100
In dark only	63 ± 04	23	36	4 21	3 01	0335	95
In light only	61 ± 03	22	36	3 57	2 68	0275	73

* Each lot consisted of 6 similarly treated flasks containing two plants each Data reported are for the average flask of two plants

light Further, the root to top ratios indicate that the nitrogen requirement was satisfied almost as well by part time as by continuous exposure to nitrate, for it has been observed that an unfavorable condition for absorbing an essential ion usually produces an increase in the root to top ratio [1] The somewhat smaller quantity of nitrogen assimilated by plants receiving nitrate only in the light, as compared with the quantity taken up by plants receiving nitrate only in the dark, may be due to the comparatively short duration of the light period, 7 hours as compared with the 17 hours of darkness

Since the plant appears able to take up practically all the nitrogen it needs in complete darkness, it seems that investigations dealing with the influence of light of different intensities and wave lengths on nitrate absorption are more or less beside the point [2] Evidently, the effect of light on ion absorption is indirect, the direct effect of light being on carbohydrate synthesis or on changes in organic matter which in turn control ion absorption This is indicated by experiments of other investigators who found that seedlings and cuttings maintained continuously in the dark absorbed nitrate only in proportion to their carbohydrate or sugar reserves [3,4,5] Hoagland's[6] experiments with *Nitella,* which took up bromine only in the light, are not necessarily contradictory, since his experimental conditions did not preclude the possibility that bromine absorption was dependent on changes in organic matter that take place only in the light

That the absorption of an ion may take place in the dark, lagging behind processes which take place in the light, is in harmony with the delayed absorption of ions that necessarily takes place when plants are grown in fractionated solutions, that is, grown alternately in different incomplete solutions Gericke[7] has claimed that plants may grow even better when alternated between a complete solution and a phosphorus free than when grown continuously in a complete solution

Whether plants grown under ordinary field conditions usually take up nitrate chiefly in the light or in the dark can be answered certainly only by further experiments But if the preceding explanation is correct—that nitrate absorption is dependent on synthesis or changes in carbohydrates in the light—it seems that most of the nitrate would be taken up in the light A lesser part, however, would be taken up in the dark, since the last quantity of organic matter changed in the light would presumably exert a "pull" on nitrates in the dark The optimum condition for growth would obviously be when nitrates are available both in the light and dark, as shown in the above experiment

P L GILE

BUREAU OF CHEMISTRY AND SOILS

U S DEPARTMENT OF AGRICULTURE

PERMO-CARBONIFEROUS COAL SERIES RELATED TO SOUTHERN HEMISPHERE GLACIATION

DURING the early Carboniferous (Early Mississippian) there were broad clear inland seas in various parts of the world in which thick masses of limestone accumulated On top of these limestones is found a series of rocks extending up into the Permian which are of a very different character These consist of numerous alternations between coarse terrestrial sediments, such as sandstone, arkose and conglomerate, and marine sediments, such as shale and limestone Such alternations have been called sedimentary cycles Be-

[1] P L Gile and J O Carrero, *Jour Agr Res* 31 545–573, 1921

[2] W E Tottingham, *Plant Physiol*, 9 127–142, 1934

[3] N Suzuki, *Bull Coll Agri Tokyo,* III 488–508, 1897–98

[4] M E Reid, *Am. Jour Bot* 13 548–574, 1926

[5] M E Reid, *Bot Gaz*, 87 81–118, 1929

[6] D R Hoagland and A R. Davis, *Jour Gen Physiol* 6 47–62, 1924

[7] W F Gericke, SCIENCE, 40 297–298, 1924

tween the coarse clastic formations and the fine sea deposits are found most of the great coal formations which supply the markets of the world with this type of fuel

It happens that there is abundant evidence of the existence of huge glaciers in the southern hemisphere during the very times when these curious alternations of deposits were being formed[1] A relation between these continental glaciers and the sedimentary cycles has been proposed recently by the writers[2] It is well known that the growth of these various great glaciers of the Pleistocene ice age was accompanied by raising and lowering of the sea level hundreds of feet and by world wide climatic alternations Many geologists believe the Permo Carboniferous glaciers were more extensive than those of the recent ice age, and certainly the glacial conditions persisted over a much greater span of time than the recent ice age They were probably accompanied by the same waxing and waning of the ice masses The resulting changes of sea level and of world climate may have caused the alternating types of sediment which go to make up the coal series

To see how these conditions would have operated, let us start with the formation of the first great glaciers As the glaciers grew, more and more water would have been withdrawn from the shallow seas which were previously spread over much of the continental surfaces As the seas withdrew the climate would have grown colder as an accompaniment of the advancing glacial conditions and greater aridity may have resulted from the decrease of evaporating surfaces from which the atmosphere derived its moisture The net result would have been the killing of vegetation on the slopes of the mountainous lands which were supplying the inland basins with sediment Since most semi arid regions now have periodic heavy rains, it is likely that these barren mountain slopes would have been subjected to violent storms with accelerated erosion and coarse debris would have been spread as great fans over the emergent lowlands At this time and in subsequent glacial epochs the coarse continental sediments of the cycles would have accumulated

With the warming of the climate which led to the melting of the glaciers and the rise in sea level, the slopes would have again become cloaked with vegetation and the streams would have ceased contributing the coarse sediment which had been due to rapid slope wash As the ground water was raised on the plains and profuse vegetation began to grow, swampy conditions would have developed and in these swamps the peat which later formed coal could have accumulated The upward growth of the great tangles of vegetation may have held back the advancing seas till large accumulations had been formed in many places

When the rising seas finally overwhelmed the swamps the marine phases of the cycle set in and an accumulation of muddy sediments formed a cover over the peat beds causing the peat to turn gradually into coal After the sea level had risen sufficiently to drown the lower courses of the land valleys the muds which had been washed into the open seas would be deposited in the resulting bays and the seas would have cleared and allowed the deposition of limestone Return of the glacial climates would have led to a repetition of the cycle and of the special sequence of formations already described

The explanation which has been outlined does not attempt to account for all the phenomena observed in connection with these sedimentary formations The sequence of formations has been generalized and is actually more complex due to varying local conditions to the distance of different areas from the sources of sediment, and perhaps to the oscillatory character of the advancing and retreating seas The explanation has been proposed as a substitute to the hypothesis that the cycles were due to alternate uplift and sinking of the basins of sedimentation and of a much greater, but contemporaneous, uplift and sinking of the source areas There are mechanical difficulties in such an explanation, especially in view of the wide spread recognition of the cyclic phenomena during these periods On the other hand, earth movements probably had an important effect on the sedimentation, but it seems likely that these movements were largely of the order of slow progressive sinking of the basins in which the sediments were accumulating and slow rising of the mountainous tracts which were the source areas of the sediment

Francis P Shepard
Harold R Wanless

University of Illinois

[1] A L Du Toit, Abst XVI, International Geol Cong, p 27

[2] Harold R Wanless and Francis P Shepard, "Sea Level and Climatic Changes Related to Late Paleozoic Cycles of Sedimentation" Presented before the Geological Society of America, December 29 1934

BOOKS RECEIVED

Annales de L Acfas Vol 1 1935 Pp 177 Association Canadienne-Française Pour L'Avancement des Sciences Montreal

Cameron Gladys *Essentials of Tissue Culture Technique* Pp xvi + 134 Illustrated by C G Grand. Farrar and Rinehart $3 00

Magie William F *A Source Book in Physics* Pp xiv + 620 111 figures. McGraw Hill $5 00

Roule Louis *Fishes and Their Ways of Life* Pp viii + 312 Translated by Conrad Elphinstone Norton $3 75

Stormzand M J and Robert H Lewis *New Methods in the Social Studies* Pp ix + 223 Farrar and Rinehart $1 75

Wilson Carl and Julia M Haber. *An Introduction to Plant Life* Pp xiv + 493 315 figures Holt $3 00

SCIENCE

Vol. 81 FRIDAY, MAY 31, 1935 No. 2109

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

PHOTONS IN CHEMISTRY AND BIOLOGY[1]

By Professor FARRINGTON DANIELS

PROFESSOR OF CHEMISTRY, UNIVERSITY OF WISCONSIN; GEORGE FISHER BAKER NON-RESIDENT LECTURER IN CHEMISTRY, CORNELL UNIVERSITY

I APPRECIATE the honor of being invited here and the privilege of living in beautiful Ithaca this semester. Wisconsin and Cornell Universities have always been close to each other. From the time of Babcock on, Cornell has sent many young men west to carry the inspiration of research to Wisconsin. Each university has vigorously directed the genius and energy of her students into useful paths.

My subject to-night is "Photons in Chemistry and Biology." The unit of light is the photon, the unit of chemistry is the molecule, and the unit of biology is the living cell. I propose to describe their general properties and their mutual interactions.

What do we know about light? We know that light affects the eye and makes vision possible. We know that light travels with an enormously rapid velocity—180,000 miles per second. We know that white light is made up of various kinds of light having different wave-lengths and that it is absorbed to a different extent by various objects through which it passes. When an object appears red we know that the blue and the yellow and the green and the other wave-lengths have been absorbed, leaving only the red to reach the eye.

When we ask the fundamental question as to what light is, we find ourselves in difficulties. The optical properties of light are very nicely represented by the hypothesis of a wave motion in a hypothetical ether. But this hypothesis is of little help in chemistry or atomic physics. In these fields we prefer to imagine a beam of light as a shower of photons—little bundles of radiant energy distributed in a random fashion in a beam, like bullets from a machine-gun.

On the other hand, this concept is of little use in

[1] A public address delivered at Ithaca, New York, on February 21, 1935.

describing the phenomenon of refraction and interference So we have one and the same beam of light explained by two entirely different models Obviously there is something incomplete about our pictures, and this incompleteness is always characteristic when we try to penetrate to fundamentals

What do we know about chemical action? We know that all matter is made up of molecules which are characteristic of the particular substance involved, that all these molecules are composed of less than a hundred different atomic species, that only a score of these elements are at all common and that a dozen of these are necessary for life processes

Our pictures of atoms and molecules change in style quite rapidly—from valence hooks, to electron pairs and cubes in 1916, to a maze of electrons rotating in elliptical orbits in 1923, and finally to the mathematical equations of wave mechanics of the present models It is always a difficult problem to decide between complete accuracy and practical simplicity in the choice of hypotheses In this case the wave equations are rarely used by chemists and the simple idea of valence is sufficient for elementary work, but the electron pair is useful for advanced work

The phenomenon of chemical reaction can be interpreted in terms of energy better than in terms of mechanical models We know that when chemical action takes place, atoms are transferred from one molecule to another In order to make these transfers possible, it is necessary to introduce energy or, in other words, to activate the molecule

This activation seems to be a necessary precursor to most chemical reactions, and the needed energy may be introduced in a variety of ways—by bombarding molecules with photons of light or with rapidly moving particles which have an electrical charge or by transferring the energy from a previously excited molecule But in most ordinary reactions the activation is produced by collisions between molecules There is satisfactory evidence that in any material above absolute zero the molecules are in a state of rapid, random motion, the velocity depending on the temperature The probability distribution of these moving molecules has been worked out with mathematical precision and checked by experiment

Now the total number of collisions at room temperature increases only about 3 per cent for a rise of 10° C, but most chemical reactions increase in velocity by 200 or 300 per cent over this temperature range It might appear, then, that there is no connection between molecular collision and chemical reaction, but it is only the few, very rapidly moving molecules which can supply energy sufficient to produce chemical activation, and their number is increased enormously by increasing the temperature

What do we know about biochemical reactions? We know that living organisms exchange matter and energy with their environments and that they have the ability to reproduce themselves The cells are composed of molecules, and the life processes are largely interpretable as chemical reactions and physical processes I remember commenting to a biologist that biochemical reactions are very complex Quick as a flash he retorted, "Yes, but so is any reaction in a test tube" I have had the truth of this statement vividly impressed on me during a fifteen year study of chemical kinetics We do not know what life is, but we do not even know what an atom is, or a photon

We have surveyed briefly what is known in general terms of the fundamental units of light, chemistry and biology We next turn our attention to mutual interactions between these different units and discuss the ways in which photons and molecules influence each other

When a beam of white light is refracted by a prism it is spread out into its different wave-lengths—in other words, the various photons are placed in different places depending on the energy which they contain The photons of greatest energy are displaced farthest from the direction of the original beam Only the photons of intermediate energy are able to affect the human eye and give the sensation of light Of these, the photons which give the sensation blue contain more energy than those which give the sensation red Beyond the red lies the region called infra red, well known as heat radiations, and beyond these the long electromagnetic waves, familiar to any one who turns a radio dial These photons have comparatively little energy Radiation of wave lengths shorter than the visible is termed ultra violet It contains photons of greater energy and it is refracted more At still shorter wave lengths and greater energy lie the x rays, and beyond them the cosmic rays The fundamental nature of radiation is the same throughout this whole range, but the chemical and biological effects are very different

When radiation is passed through matter, some of the photons in the beam are stopped by molecules A photon can be stopped by a molecule only when the molecule can rearrange its structure to take up just the amount of energy contained in the photon Under these conditions radiation is converted into chemical energy or into heat Even if the molecule is capable of this rearrangement it will not absorb the photon unless there is also an intimate collision between the photon and the molecule Accordingly, the percentage of photons stopped depends on the ratio of molecules to photons, a fact which finds expression in Lambert's law regarding the thickness of the absorbing medium,

and in Beer's law regarding the concentration of the absorbing solution.

Considerable progress has been made in visualizing the method by which molecules absorb the energy of the different photons. Heat radiations in the far infra red cause a molecule to rotate, while the photons in the near infra red cause the atoms in the molecule to stretch apart and vibrate. Photons in the visible region of the spectrum are able to make more violent changes. They can displace the electrons which hold the atoms together in the molecule. In the ultra-violet the mechanism is the same except that the energies involved are greater and the electronic displacements are greater. X-ray photons are more powerful still. They can be stopped only by doing a more drastic thing—namely, displacing an electron deep down within an atom near its nucleus.

It has been found that most chemical reactions which proceed with measurable velocity at and above room temperature require for activation roughly from 20,000 to 60,000 calories per gram molecule. This much energy is available in the photons of visible light. More than enough energy is available in ultra-violet and x-ray photons, but infra-red and radio waves are not able to bring the molecules to a sufficient state of activation to effect chemical reaction.

Our guiding principle in the understanding of radiation is the quantum theory. The most important expression of this theory for chemists is the Einstein law of photochemistry, according to which one molecule is activated for each photon absorbed. It must be remembered that after a molecule becomes activated a great many things may happen to it, and only rarely does each activated molecule produce one molecule of a new chemical product. The phenomena are so complex that actual experimental proof of this law is very meager, but it is generally accepted and useful.

The photo-chemist is not concerned with the amount of light that *passes through* the reacting system; he wants to know how many photons are *absorbed* by the reacting system. He then measures the number of molecules reacting, and this ratio of molecules to absorbed photons gives him valuable information regarding the mechanism of the process. If the ratio is unity, the reaction is probably a primary reaction to which Einstein's law applies. If it requires many photons to make one molecule react, there are complications, and either some of the activated molecules are dissipating their energy as heat, or a second reaction is taking place in such a way that it is not noticed, or thirdly, a reverse reaction is offsetting the photochemical reaction.

On the other hand, if the ratio of molecules to photons is greater than unity a chain reaction is involved. One molecule becomes excited and the product of the reaction is able to activate another molecule, and many molecules simply follow blindly after the leader, like a series of ten pins. Carried to extremes the chain reaction may become an explosion. The investigations of photochemistry offer excellent opportunities for studying chain reactions, and it is becoming increasingly apparent that they are very common in both chemistry and biology.

We have been discussing the chemical action of photons on molecules. Let us look for a minute at the reverse process in which chemical reactions emit photons—the phenomenon of chemiluminescence. You are familiar with phosphorescent substances, such as decaying wood, or phosphorus glowing in the dark, or bacteria in sea water being oxidized as a boat plows through the water. Perhaps the most striking illustration of all is the ordinary firefly. In all these phenomena a chemical reaction gives rise to the displacement of an electron (or atom) in a molecule, and when the electron falls back into its normal position of lower energy, a photon of radiation is emitted. At first sight one wonders why the phenomenon of chemiluminescence is not more common than it is. Apparently rather special conditions must exist. The absorption must be slight in order that the photons emitted in the interior of the reacting medium can escape and be detected. Again, unless this particular photon happens to fall in the energy region corresponding to visible light, the chemiluminescence will not be detected by the eye. It is quite likely that intensive searches for chemiluminescence in the infra-red region of the spectrum may show that chemiluminescence is a fairly common phenomenon.

Turning next to photo-biology, I want to emphasize that this field is but a special application of photochemistry. The effects produced in living matter by photons are due merely to ordinary photochemical reactions in which the photons displace electrons within the molecule, and the molecule then rearranges or combines with other molecules. I shall confine my remarks to a few specific cases of photo-biology.

I have always wondered that more attention has not been paid to the fundamental process of photo-synthesis by chlorophyll in green plants. Millions of dollars have been spent in agricultural experiment stations on applied problems, but only a few laboratories have ever been concerned with a study of the primary process which lies back of all plant growth. It is a process of extraordinary importance, since it supplies the material which provides the energy of animals and man and the energy of engines. Chlorophyll is a complex organic substance which absorbs photons in the visible region of the spectrum, and in the plant causes carbon dioxide and water to combine, giving

various carbohydrates and a number of more complex organic substances

The mechanism by which carbon dioxide and water unite in the presence of chlorophyll and photons is by no means understood It is clear that over 100,000 calories of energy are required for the production of a gram molecule of material and that the photons of visible light do not contain as much energy as this Only in the very short ultra violet would one expect the photons to be sufficiently powerful to cause the direct union of carbon dioxide and water However the living cell *does* use visible light, and the manner in which it is able to combine several of these photons of lesser energy in such a way as to bring about this important reaction is a matter of great interest It is unique in photochemistry

Passing next to mitogenetic rays it must be emphasized that this subject is still controversial About ten years ago a Russian investigator, Gurwitsch reported that rapidly growing cells such as the tip of the onion root, emit radiation of short wave lengths and are able to accelerate growth in neighboring cells This mysterious radiation was able to penetrate quartz but unable to penetrate glass Several hundred papers have followed in this field but the results are in no way conclusive Some investigators find mitogenetic rays emitted by a variety of living tissues and increased growth has been reported in yeast cells in young bacteria and in certain plants Obviously a more reliable check of these mitogenetic rays would lie in detection by physical means such as photographic plates and ionization chambers Unfortunately, the photographic plate is far too insensitive to be considered Very sensitive Geiger chambers have been used, in which a photoelectric effect is combined with an amplified ionization current so as to register electrical currents when a few individual photons enter the chamber Some investigators have reported positive effects with Geiger chambers, but others have failed There is no fundamental reason why some chemical reactions occurring in life processes should not emit photons We have discussed this matter already under chemiluminescence But whether or not such radiations if they exist, have any biological significance is a matter for the future to decide

You are familiar with the use of infra red lamps for physical therapy These photons in the infra red are able to penetrate animal tissue beyond the surface layer The energy which they contain is not enough to bring about chemical reaction, but they penetrate deeply and dissipate their energy as heat In other words, infra red radiation offers a convenient means for heating tissue considerably below the surface, and in this way it is possible to increase circulation of blood or bring about improvement in stiff joints and in certain diseases The photons in visible and in ultra violet light are stopped at the surface, but at still shorter wave lengths we get the deeply penetrating x rays Since the photons of x rays contain large amounts of energy they can bring about violent reactions and destroy tissue either at the surface or deep in the body Gamma rays from radium are similar in character to the x rays, and both of these agents are useful in the destruction of rapidly multiplying cells such as are found in cancer

One of the most intriguing applications of photochemistry to biology is that of the mutations produced by x rays, as discovered by Muller in his study of fruit flies Fruit flies have been studied from a genetic standpoint for a long time, and experts are able to predict with considerable certainty the number of new variations which may be expected in a pedigreed colony These variations include color of eyes and various biological characteristics which might not be evident to an inexperienced observer When these fruit flies are exposed to x rays before breeding, the number of variations in offspring is greatly increased This same phenomenon has been found in various other organisms—in the much studied and pedigreed tobacco plant, for example Through remarkable advances in microscopic technique it has been found that this x ray treatment actually dislocates certain cells in the chromosomes which control the hereditary features These dislocations of the chromosomes give a mechanical picture which agrees perfectly with the hereditary features as catalogued by the geneticist The photochemist can claim this as one of his reactions A photon hitting a vital spot in the cells of a chromosome is able to start a chemical reaction which on multiplication gives this mechanical distortion which in turn leads to the variations in the species The penetrating photons of x rays are thus uniquely favorable for bringing about changes inside the cell and any mechanical stimulus designed to produce the same effect would be impossible because of the attendant destruction of the cell The question arose as to whether all naturally occurring mutations may not be caused by photons coming from the deeply penetrating but rather infrequent cosmic rays or from gamma rays in traces of radio active material Certainly the naturally occurring mutations which make possible biological evolution, can be explained in part as photochemical reactions, but the number of mutations appears to be considerably greater than can be completely accounted for by this mechanism

The cure of rickets by ultra-violet light constitutes one of the most interesting chapters in photo biology, and because of the intensive work which has been done in this field we are able to draw rather definite conclusions Ten years ago it was thought that the radia

tion produced some mysterious effect in an animal in such a way that calcium was deposited in a normal manner in the bones Some thought that the photons themselves were the primary cause of the calcium deposition When Steenbock found that the radiation of food was just as effective as the radiation of the patient, the problem obviously became one of simple photochemistry Separating the various parts of the food it was soon found that the cholesterol, later ergosterol, was the material which, when acted upon by light, brought about the normal deposition of calcium Little was known about the actual vitamin D or the mechanism involved In a cooperative research with Professor Steenbock, starting in 1927, we determined the minimum amount of energy of ultra violet radiation necessary to prevent rickets in a rat From this value we calculated the number of photons and the number of molecules, on the assumption that the Einstein law applied Assuming further that the molecular weight of vitamin D is practically the same as that of its precursor, ergosterol, we calculated that 60 billionths of a gram should be a sufficient dosage to prevent rickets in a rat Two years later, Bourdillon and Webster produced the practically pure vitamin D and found that 50 billionths of a gram was necessary, a quantity which was practically identical with the prediction based on photochemistry

When Steenbock discovered the effect of irradiating food with ultra violet light, he saw the social implications of his discovery He saw a gullible public swayed by the word "vitamin' and the word "radiation", he saw an American dairy industry competing strenuously with butter substitutes, and a Norwegian fishing industry largely dependent on the production of vitamins He realized that every corner drug store could radiate its own vitamin D and that it would be years before the government could get things standardized People would buy material that was dangerously over irradiated and worthless material that was under radiated Here was a "baby on the doorstep," and something had to be done He took his discovery to the university, but the university was not equipped to handle it He was offered a large sum for the discovery, but he did not want it He pioneered along new lines, and the Wisconsin Alumni Research Foundation was organized Alumni of the university, busy business men, serving without pay, control the policies and give the profits to the university to support further research Neither the university nor any of its faculty has anything to do with the foundation's business or policy The university simply accepts without any strings the moneys which the foundation gives it, and a faculty committee allocates it where it will do the most good in furthering the research program of the university

The social implications of research are enormous The scientist can no longer toss his bombs of discovery promiscuously on a helpless humanity without warning He must cooperate with the social scientist and the statesman The problem of obsolescence must be faced

Take a specific case, hypothetical, but not beyond the realm of possibility a few decades hence Suppose that botanists, photochemists, organic chemists and engineers, working together, are able to synthesize food material on a commercial scale from carbon dioxide and water, using sunlight and some kind of an artificial chlorophyll in which the living plant and the soil are not necessary What should be done with such a discovery? It would be hailed as a remarkable achievement and an insurance against world starvation in case of enormous over population, an unprecedented period of drought or the advent of another ice age The tropical and arid regions with sunshine, but little soil, could produce the necessary food in troughs instead of in plowed fields But what about the effect on the chief industry of the world—agriculture, and all the human and economic factors which are interwoven with it? There are enough difficulties in this field already without bringing in new competition Research along these lines and all others must be given every encouragement because no one knows what is ahead, and a reserve stock of scientific knowledge is the best equipment for emergencies and for new improvements In the *application* of scientific discoveries to human affairs, however, the most unselfish and far visioned statesmanship is necessary Advance warning and cooperation by scientists and slow development through a transition period to allow economic readjustment are necessary The principle that those who profit by a new application must help those who lose by it should become well recognized

Nothing which I have said must be taken to imply any regimentation in or dictatorship of scientific research itself Scientific research is spontaneous and must not be spoiled by interference Cooperation between scientists is absolutely essential—but it already exists It is thrilling to see how scientific advances come about through the unconnected and independent efforts of different men publishing their results in scientific journals

To illustrate, I should like to refer to the discovery and use, in science, of heavy hydrogen A precise physicist in California liked to calculate the exact constants of nature and to study them critically He came to the conclusion that the atomic weights were such that hydrogen must contain a heavier isotope, probably with a mass of two instead of one A physical chemist in New York had spent a great deal of his life in studying the properties of hydrogen and of

water. He was thoroughly familiar with spectroscopy. He conceived the idea that this heavier isotope of hydrogen must exist in quantities too small to detect, but that continued fractional distillation of hydrogen would produce a concentration. He joined forces with a physicist at the Bureau of Standards at Washington who had developed extensive machinery for liquefying hydrogen at very low temperatures. Fractionation in this apparatus gave material with a new spectral line, faint, but unmistakably at the position where calculations showed that it should be if it had a mass of 2. A physical chemist at the Bureau of Standards conceived the idea that electrolysis of water might be a simpler way of concentrating this heavier isotope of hydrogen, and, together with the discoverer of heavy hydrogen, he started to electrolyze a large quantity of water and let it go for a few months, as a side issue. Sure enough, the residue of this electrolysis gave water of slightly increased density.

Immediately well-equipped and forceful departments of chemistry, at California and at Princeton, at Columbia and elsewhere started to electrolyze on a large scale. A communication from the California laboratory to the editor of the American Chemical Society two years ago announced that the separation could be carried very far and that pure isotopic hydrogen might be obtained. Immediately many chemists all over the world dropped their tools and started investigations in this most intriguing field.

In the meantime other investigators were helping unknowingly to advance this field. Commercial electrolysis of water for the production of hydrogen and oxygen had left residues richer in the heavy hydrogen, and these now suddenly became important. A young mining engineer from the West, with a quick mathematical mind, became interested in chemical kinetics, and he was able to visualize energy levels in molecules in the same way that he visualized topographical lines on a map. With this he was able to go far towards predicting reaction rates, and heavy hydrogen proved a fruitful field in which to apply and test these mathematical concepts. Physicists in various parts of the world had been trying to obtain higher and higher voltages in order to smash atoms. Heavy hydrogen gave a new projectile by means of which this smashing could be effected. And now in several laboratories one can actually see and hear the individual atoms as they are transmuted in accordance with the ancient dream of the alchemist. Chemists are attacking the problem of reaction mechanism along new lines, for they can now label the hydrogen atom and follow it through various reactions.

Looking back on this three-year development of heavy hydrogen, my claim is that no one could have had the wisdom to direct research along these different lines in such a way as to produce better results. Each of these different contributors to scientific research was impelled only by his interest and enthusiasm in creative work, and any regimentation would have been fatal. We must not interfere with our scientists. We must not starve them nor frighten them, for the progress of the world depends upon them. Research in science has been one of the few outstanding successes in the human race, and we need not less, but more of it.

SCIENTIFIC EVENTS

THE ELECTROSTATIC GENERATOR AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ADVANCES in the development of electrostatic generators and the application of high voltage direct current electricity at the Massachusetts Institute of Technology were announced on May 23 by Dr. Karl T. Compton, president of the institute, at a meeting of the board of directors of the Research Corporation in New York.

The giant electrostatic generator built at the research station of the institute on the estate of Colonel E. H. R. Green at Round Hill, Mass., by Dr. Robert J. Van de Graaff and his associates, Dr. Lester Van Atta and Dr. Chester Van Atta, has been equipped with accurate voltage and current controls as well as vibration eliminators. It is now ready for the vacuum discharge tube, in which experiments in atomic disintegration are expected to begin this year. The generator develops approximately 7,000,000 volts, one of the limitations on higher voltage being flash-over to the roof of the airship dock in which it stands.

During the past year the Round Hill research staff has been engaged principally on the design and construction of the vacuum discharge tube now being prepared for operation by the generator. Much of the progress of the past year has been made possible by grants from the Research Corporation. During the coming year this vacuum tube unit will be employed in a series of experiments on nuclear disintegration in the lower voltage range, while the other additional units of the tube, which will permit extension of the experiments to higher voltage ranges, are under construction.

In the laboratories of the institute at Cambridge, under the supervision of Professor Van de Graaff and Dr. John G. Trump, attention has been concentrated on the ability of a vacuum to sustain high voltages.

An important result of these investigations has been the construction and preliminary test of apparatus for generating very penetrating x rays, which possesses several advantages as compared with machines hitherto available The penetrating x rays have their practical application in the treatment of internal cancer The present apparatus consists of a Van de Graaff belt generator, coupled with a modified Lauritsen x ray tube, in which all aspects of the equipment have been satisfactorily tested for production of x rays up to 700,000 volts

SYMPOSIUM ON IONIC PHYSICS AT CORNELL UNIVERSITY

ARRANGEMENTS have been made for holding a Symposium on Ionic Physics at Ithaca, N Y, during the week end immediately preceding the opening of the Cornell 1935 Summer Session

A three day program (July 4, 5 6) devoted to a discussion of photoelectricity and thermionics has been prepared It is the purpose of this symposium to provide a comprehensive survey of these fields, with ample time and opportunities for discussion

The various phases of the subjects will be introduced by the following invited papers

Thursday Morning, July 4, 9 30 o'clock (E S T)

"The Present Status of Thermionics," Saul Dushman General Electric Company

"Surface Ionization Potentials," J A Becker Bell Telephone Laboratories

Thursday Afternoon, 2 o'clock

"Optical Factors in the Photoelectric Effect," H E Ives, Bell Telephone Laboratories

"Photoelectric Conductivity," F C Nix, Bell Telephone Laboratories

Friday Morning, 9 o'clock

"Photoelectricity, Experiment *versus* Theory," L A DuBridge, University of Rochester

"Theory of Metals and Electron Emission Phenomena," J C Slater, Massachusetts Institute of Technology

Friday Afternoon, 2 o'clock

"Fluorescence and Photochemistry, Applied to the Assimilation Process of Carbon Dioxide," J Frank, The Johns Hopkins University (visiting lecturer in physics Cornell Summer Session)

Saturday Morning, 8 30 o'clock

"Electron Optics," C J Davisson, Bell Telephone Laboratories

"Properties of Thoriated Tungsten Filaments," W B Nottingham, Massachusetts Institute of Technology

"The Electrical Properties of Adsorbed Films on Metals," Irving Langmuir, General Electric Company

There will be a registration fee of one dollar for those attending the symposium

Arrangements will be made for housing the group in attendance, including families, in one of the university dormitories for the nights of July 3, 4 and 5, at $2 00 per night per person ($5 00 per person for the three nights) Reservations for such rooms should be made in advance with the Manager of Residential Halls, Morrill Hall, Ithaca, N Y For further information, address Professor R C Gibbs Rockefeller Hall, Ithaca, N Y

MEETINGS OF SIGMA XI

A CHAPTER of Sigma Xi was installed at Smith College on May 1 Dr Harold Clayton Urey, of Columbia University, was the guest lecturer, Professor George Howard Parker, of Harvard University, national president, and Professor Edward Ellery, of Union College, national secretary, were the installing officers In addition to those already members of Sigma Xi, fourteen members of the faculty were initiated Delegates from Sigma Xi chapters of thirteen colleges attended the installation ceremony

Dr E C Stakman plant pathologist at the University of Minnesota, was guest speaker on May 16 at the Sigma Xi initiation banquet at Cornell University He spoke on the subject 'Routing the Red Scourge of Wheat" Dr Stakman also gave a public Sigma Xi lecture on "Rubber Growing in Liberia and the East Indies" on May 17 He was the guest of the department of plant pathology during the entire week

At the first annual meeting of the Tulane Chapter of the Society of the Sigma Xi twenty one associate members were initiated The annual address, entitled "A Problem of Three Bodies" was given by the retiring president, Professor Herbert E Buchanan, head of the department of mathematics of Tulane University The officers for the coming year are as follows *President,* Dr Ernest Carroll Faust, professor of parasitology, *Vice president,* Professor William B Gregory, of the department of sanitary engineering, *Secretary Treasurer,* Dr Harley N Gould, head of the department of biology, Newcomb College, additional members of the *Executive Committee,* Dr Nola Lee Anderson, department of mathematics, Newcomb College, and Dr Edward S Hathaway head of the department of zoology, Tulane University

The District of Columbia Chapter of Sigma Xi at a meeting on May 14 elected the following officers *President,* Dr William Bowie, chief, Division of Geodesy, U S Coast and Geodetic Survey, *Vice-president,* Dr Frederick V Coville Bureau of Plant Industry, *Secretary,* Dr V A Pease, Bureau of Chemistry and Soils, *Treasurer,* William Lerch, National Bureau of Standards At this meeting the following

new members were presented Dr Oscar Sherman Adams, senior mathematician, U S Coast and Geodetic Survey, Dr Sidney Fay Blake, senior botanist, Bureau of Plant Industry, and Dr John Robbins Mohler, chief, Bureau of Animal Industry Mrs Elizabeth Aldrich Bridgeman, recently elected an alumna member at Tulane, was presented at the request of that chapter

AWARD TO DR KRAUS OF THE WILLARD GIBBS MEDAL

DR CHARLES A KRAUS, professor of chemistry at Brown University and director of the Newport Rogers Laboratory, was presented with the Willard Gibbs Medal of the Chicago Section of the American Chemical Society at a ceremony at the Stevens Hotel on May 24 Professor Roger Adams, of the University of Illinois, president of the society, presented the medal, one of the highest scientific honors bestowed in the United States, to Dr Kraus, citing his valuable contributions to the knowledge of reactions in liquid ammonia, enlargement of the understanding of the chemical behavior and characteristics of metals and extensive development of the field of the elements germanium and gallium"

An ammonia world was described by Professor Edward Curtis Franklin, of Stanford University who, speaking on 'Kraus, the Man," traced the development of ammonia research since a group at the University of Kansas, including Dr Kraus, Professor Franklin and Professor Hamilton P Cady, founded a new school of chemists in 1896 The title of Dr Kraus's address was 'Concerning Chemistry and Chemists"

Dr Kraus received the Nichols Medal of the New York Section of the American Chemical Society in 1923 for his work with non aqueous solutions He has lectured at the University of Chicago, Western Reserve University and Harvard University, and has been consulting chemist for the U S Bureau of Mines, the Chemical Warfare Service and the Fixed Nitrogen Research Laboratory, as well as for various technical developments

The 1936 Willard Gibbs Medal Jury of Award was composed as follows

Professor Adams, Dr Phoebus A Levene, Rockefeller Institute, New York, Professor Joel H Hildebrand, University of California, Professor Ross A Gortner, University of Minnesota, Professor Hugh S Taylor Princeton University, Professor Julius Stieglitz, University of Chicago, Professor Moses Gomberg, University of Michigan, Carl S Miner, director of the Miner Laboratories, Chicago, Professor Franklin, Professor H I Schlesinger, University of Chicago, Dr Willis R Whitney, General Electric Company, Dr Harrison E Howe, editor of *Industrial and Engineering Chemistry*

Previous medalists were Svante Arrhenius, of Sweden, Mme Marie Curie, of France, Sir James C Irvine, of Scotland, Dr Richard Willstatter, of Munich, and the following Americans Theodore W Richards, Leo H Baekeland, Ira Remsen, Arthur A Noyes, Willis R Whitney, Edward W Morley, William M Burton, William A Noyes, F G Cottrell, J Stieglitz, G N Lewis, Moses Gomberg, John Jacob Abel, William Draper Harkins, Claude S Hudson, Irving Langmuir, Phoebus A Levene, Edward Curtis Franklin and Harold C Urey

On the following day, Dr Kraus read a paper on 'The Present State of the Problem of Electrolytes," under the joint auspices of the University of Chicago and the Chicago Section of the American Chemical Society

THE RETIREMENT OF PROFESSOR ERNEST MERRITT

THE retirement of Professor Ernest Merritt, after forty six years of service in the department of physics, was the occasion for the gathering at Cornell University of over one hundred Cornell physicists on May 4 in his honor In the afternoon Professor Merritt presided at a meeting of the Physics Seminary, in which he has been active since it was organized by Professor E L Nichols forty five years ago Papers were presented by Dr Frances G Wick, professor of physics at Vassar College, and Dr W W Coblentz, physicist at the National Bureau of Standards

At a dinner in Willard Straight Hall held in the evening in honor of Professor Merritt, letters from his former associates were read by Professor R C Gibbs, chairman of the physics department Addresses were made by Dr Livingston Farrand, president of Cornell University, Dr Ernest Blaker, physicist with the Goodrich Rubber Company, formerly professor of physics at Cornell, and Dr J O Perrine, physicist with the American Telephone and Telegraph Company Professor Merritt recalled early incidents in the development of physics at Cornell and spoke optimistically of the future

Professor Merritt, in addition to his long service in the department of physics, of which he was the head from 1919 until 1934, was dean of the Graduate School from 1909 to 1914 and for three years served as faculty representative on the Board of Trustees He was editor of *The Physical Review* for twenty years, when it was conducted under the auspices of Cornell University, and was the first secretary of the American Physical Society of which he later became president During the war he was active in research at the Naval Experiment Station at New London.

RECENT DEATHS

DR. HUGO DE VRIES, professor of botany at the University of Amsterdam from 1878 to 1918 and director of the Amsterdam Botanical Garden, died on May 21 He was eighty-seven years old

DR. HERBERT HENRY THOMAS, petrographer to the Geological Survey of Great Britain, died suddenly on May 12 He was fifty nine years of age

THE death at the age of seventy two years is announced of Sir James Walker, emeritus professor of chemistry in the University of Edinburgh

DR. LEOPOLD REINECKE, consulting geologist Johannesburg, South Africa, died on April 16, in his fiftieth year

M LOUIS JOUBIN, of the Museum of Natural History and the Institute of Oceanography, Paris, died on April 24

DR. PEDRO GUTIERREZ IGARAVIDEZ who was associated in work on hookworm disease with the late Dr Bailey K Ashford, died on May 24, at the age of sixty four years

DR BUNJIRO KOTO, professor emeritus of geology, Tokyo Imperial University, foreign correspondent of the Geological Society of America, died on March 8

SCIENTIFIC NOTES AND NEWS

DR SIMON FLEXNER, director of the laboratories of the Rockefeller Institute for Medical Research since the opening of the institute in 1903, has presented his resignation to take effect on the appointment of his successor

DR. FRANK R LILLIE, professor of embryology and dean of the division of biological sciences of the University of Chicago, will retire at the close of the academic year with the title emeritus Dr William H Taliaferro, head of the department of hygiene and bacteriology, has been appointed dean of the division, effective on July 1 Dr Lillie was recently elected president of the National Academy of Sciences and chairman of the National Research Council

DR. CHARLES RUSS RICHARDS, president of Lehigh University, has presented his resignation to the Board of Trustees on account of protracted ill health Before becoming president of Lehigh in 1922 Dr Richards was director of the Engineering Experiment Station at the University of Illinois Eugene G Grace, president of the board and of the Bethlehem Steel Corporation, has appointed a committee of trustees to seek a successor

PROFESSOR G W HERRICK will retire from active teaching in June For more than a quarter of a century he has taught the large beginning class in general entomology in Cornell University He has also been entomologist of the Cornell Experiment Station and has published many bulletins and several books on economic insects In recognition of his services a testimonial dinner was given him by his colleagues and friends on the evening of May 23 Addresses were made by Drs Liberty Hyde Bailey, Cornelius Betten, P J Parrott and Simon Henry Gage

PROFESSOR EMIL ABDERHALDEN, director of the Physiological Institute at Halle, has been elected a foreign member of the Lombardy Society of Medicine and a corresponding member of the Pontifical Academy of Sciences in Vatican City

Nature reports that F G Donnan professor of general chemistry in the University of London has been elected an honorary member of the Chemical Society of Rumania Professor Donnan gave three lectures before the Danish Natural Science Association at Copenhagen during the week of May 20

OFFICERS and councilors to serve during 1936 have been nominated by the council of The Geological Society of America as follows *President*, W C Mendenhall, Washington, D C, *Past President*, Nevin M Fenneman, Cincinnati, *Vice presidents*, W E Wrather Dallas, George D Louderback, Berkeley, C K Swartz, Baltimore, C S Ross, Washington, D C, *Secretary*, Charles P Berkey New York, *Treasurer* Edward B Mathews, Baltimore, *Councilors* (1936–1938), Joseph Stanley Brown New York, Thomas L Walker, Toronto, G F Loughlin, Washington, D C The election will take place at the 1935 annual meeting to be held in New York City on December 26, 27 and 28

AT the eighteenth annual meeting of the American Society of Ichthyologists and Herpetologists held at the Carnegie Museum, Pittsburgh, Pa, from May 2 to 4, the following officers were elected for the ensuing year *President*, Clifford H Pope, American Museum of Natural History, *Vice presidents*, Henry W Fowler, Philadelphia Academy of Natural Sciences, Tracy I Storer, University of California, and E H Taylor, University of Kansas, *Secretary*, M Graham Netting, Carnegie Museum, *Treasurer*, A W Henn, Carnegie Museum, *Editors*, Carl L Hubbs and Helen T Gaige, Museum of Zoology of the University of Michigan

A PORTRAIT by Jacob Binder of Dr Milton J Rosenau, Charles Wilder professor of preventive medicine and hygiene at the Harvard Medical School, has

been presented to the school by his colleagues. Dr. Rosenau will retire from active teaching at the end of the current academic year. Dr. Elliott J. Joslin was chairman of the committee having charge of the project.

TRIBUTE was paid to Dr. Abraham J. Goldforb, professor of biology at City College, New York, at a dinner given on May 24 in celebration of his twenty-fifth year at the college. Speakers included Dr. Frederick B. Robinson, president of the college; Dr. Morton Gottschall, Dr. Paul Klapper, Dr. Harry A. Overstreet, Dr. William H. Park and Dr. Philip Smith.

IN celebration of the establishment in 1914 of courses in optometry at Columbia University a dinner was given on May 18 in honor of James P. C. Southall, professor of physics at Columbia University and director of professional courses in optometry, and of Professor Frederic A. Woll, director of the department of hygiene of the College of the City of New York, associate at Columbia University and member of the New York State Board of Optometry. Dr. Harlan H. Horner, assistant commissioner of higher education of New York State, and Dr. Charles B. Heisler, director of professional education, were the principal speakers. On this occasion Samuel H. Roberts, lecturer in optometry at Columbia University, received a plaque presented to him by the New York Academy of Optometry for distinguished service in optometry.

MONTANA STATE COLLEGE will confer at commencement the degree of doctor of science upon M. L. Wilson, assistant secretary of agriculture, formerly head of the department of agricultural economics at the college, and on Reno H. Sales, chief geologist of the Anaconda Copper Mining Company. Mr. Wilson will deliver the commencement address.

DR. EWEN M. MACEWEN, professor and head of the department of anatomy of the State University of Iowa, has been appointed dean of the College of Medicine. Since the retirement of Dr. Henry S. Houghton, who resigned as dean in 1932 to go to the University of Chicago, the affairs of the college have been in charge of an interim committee composed of Dr. John T. McClintock, Dr. Howard L. Beye and Dr. Everett D. Plass.

DR. PETER SANDIFORD, of the University of Toronto, has been appointed acting professor of psychology at Stanford University, for the winter, spring and summer quarters of next year.

DR. RAY LYMAN WILBUR, president of Stanford University and formerly Secretary of the Interior, has been elected president of the Motion Picture Research Council, succeeding Mrs. August Belmont, who resigned last June.

Industrial and Engineering Chemistry reports that Dr. F. D. Rossini, chemist at the National Bureau of Standards, Washington, D. C., has been appointed director of Project 6 of the American Petroleum Institute program of fundamental research. This project has for its purpose the separation, identification and determination of the constituents of petroleum. It was begun in 1928 and was directed by Dr. E. W. Washburn until the time of his death.

JULIUS J. TOROK, since 1925 with the Westinghouse Electric and Manufacturing Company, has joined the Research and Development Staff of Corning Glass Works, New York. Mr. Torok will give particular attention to the development of applications of glass to electric insulation.

THE Unionist Associations of the four Scottish universities have, by a unanimous vote in each case, adopted Professor John Graham Kerr, F. R. S., since 1902 Regius professor of zoology in the University of Glasgow, as National Unionist candidate for the impending vacancy in the parliamentary representation of the Scottish universities resulting from the appointment of John Buchan as Governor General of Canada.

M. CHARLES FABRY, of the University of Paris, member of the Institute of France, has become a member of the Bureau des Longitudes, in the place of the late Paul Painlevé. General Georges Perrin, professor at the Polytechnic Institute, has been elected a member to succeed the late M. Benjamin Baillaud.

F. TATTERSFIELD, head of the department of insecticides and fungicides of the Rothamsted Experimental Station, England, will attend the June meeting of the National Association of Insecticide and Disinfectant Manufacturers in Chicago.

A BILL has been introduced in the United States Senate proposing the authorization of an annuity to Frances Agramonte, the widow of the late Dr. Aristides Agramonte, member of the yellow fever commission.

DR. T. WINGATE TODD, professor of anatomy at Western Reserve University and director of the Hamann Museum of Comparative Anthropology and Anatomy, spoke on "The Stomach's Response to our Menu" at the annual meeting of the University of Cincinnati Section of Sigma Xi on May 17.

DR. E. K. MARSHALL, professor of pharmacology at the Johns Hopkins Medical School, delivered the annual address before the North Carolina Chapter of the Society of the Sigma Xi on April 23. His subject was "The Significance of the Aglomerular Kidney."

DR. W. W. CORT, of the School of Hygiene and

Public Health of the Johns Hopkins University, addressed the Beta Beta Beta Biological Fraternity at Western Maryland College on April 30 on "Parasitic Diseases in Rural Egypt."

THE Eugenics Research Association will meet at the American Museum of Natural History, New York, on Saturday, June 1. There will be a morning session from 10 A. M. to 1 P. M., luncheon at the Museum Restaurant, and an afternoon session from 2:30 to 4:30. Those interested in eugenical research are invited to attend.

THE one hundred and ninety-ninth regular meeting of the American Physical Society will be held at Minneapolis on June 21 and 22, preceding the summer meeting of the American Association for the Advancement of Science from June 24 to 29. There will also be a meeting of the Pacific Coast Section from June 26 to 29 at Los Angeles, Calif.

THE Pacific Section of the Botanical Society of America will hold its annual meeting at the University of California at Los Angeles on June 26 and 27, in conjunction with the meeting of the Pacific Division of the American Association for the Advancement of Science and associated societies. A symposium on "Virus Diseases of Plants and Animals" is being arranged as a joint program of several societies for the forenoon of Wednesday, June 26. The sessions of Wednesday afternoon and of Thursday morning will be devoted to the reading of contributed papers. A symposium on "Chlorophyll" in the afternoon will be followed by a dinner for all biologists that evening. The program is being arranged by the officers of the Pacific Section, O. L. Sponsler, president, and F. Murray Scott, secretary.

THE Genetics Society of America will hold a summer meeting at the Marine Biological Laboratory, Woods Hole, Mass., on August 23 and 24. At this meeting two round table conferences will be conducted, one on "How Far Genetics Can Explain Ontogeny" with A. H. Sturtevant as leader and Curt Stern and J. L. Cartledge as introducers and the other on "Chromosomes and Their Relation to Genes" with E. M. East as leader and C. B. Bridges and Barbara McClintock as introducers. An evening lecture will be given by Professor Ralph E. Cleland on August 22. The society will hold its regular winter meeting at St. Louis, from December 31 to January 2. In addition, a branch meeting will be held at Princeton from December 30 to January 1, together with the American Society of Zoologists, in order to accommodate the eastern members who will be unable to attend the regular meeting. The society will also hold a meeting in connection with the section of agriculture of the American Association for the Advancement of Science at University Farm, Minn., on June 25, in accordance with the program printed in SCIENCE for May 24.

A LOCAL branch of the Society of American Bacteriologists is being organized, to include members in Wisconsin, Iowa, Minnesota, North Dakota and South Dakota. A meeting for organization will be held at the University of Minnesota on June 26. This will be an all-day meeting, with a scientific program. It is not necessary to be a member of the parent society in order to join a local branch. Bacteriologists who may attend this meeting or who are interested in joining the branch are requested to communicate with Dr. A. T. Henrici, 18 Millard Hall, University of Minnesota.

AT Purdue University on May 17 and 18 there was held a conference for those teaching chemistry in the high schools of Indiana. The program was arranged by the Purdue department of chemistry in response to requests from the high school teachers, and consisted of talks by members of the department and a symposium dealing with the aims, subject-matter, methods of teaching and methods of measuring achievement, as pertaining to chemistry in the high schools of Indiana. At the conclusion of the regular program an organization was formed by the teachers from the high schools. Officers elected were: Frank B. Wade, of Shortridge High School, Indianapolis, *president;* C. O. Pauley, of Valparaiso, Ind.; *vice-president;* Miss June Ossenberg, of Martinsville, Ind., *secretary-treasurer.* It was voted to hold a similar meeting at the university in May, 1936.

APPLICATIONS for positions of biologist (wild-life research) of various grades in the Bureau of Biological Survey, Department of Agriculture, must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than June 17. The entrance salaries range from $2,600 to $3,800 a year, subject to a deduction of 3½ per cent. toward a retirement annuity. Specified education and experience are required.

IT is reported in the daily press that a sum of over $1,000,000 was left to the University of Maryland Medical School in the will of the late Dr. Frank C. Bressler. The bequest will be used to establish a research laboratory to be named in honor of Dr. Bressler, who died on May 17, in his seventy-fifth year.

NINE fellowships in medicine, including two renewals, for study in the United States and abroad during the year 1935–36, were awarded at the spring meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. Francis G. Blake, Sterling professor of medicine at Yale University, is the chairman. A list of the

successful candidates follows Oscar E Block, Jr, Berry Campbell, Jack M Curtis (renewal), Windsor C Cutting, Samuel Gurin, Robert E Johnson, Benjamin F Miller (renewal), E Byron Riegel, Morris F Shaffer The next meeting of the Medical Fellowship Board will be held about February 1, 1936, and applications to receive consideration at that time must be filed on or before December 15, 1935

AT a meeting of the Committee on Teaching Fellowships for the department of biology, Washington Square College of New York University, the following awards were made Olive F Bartholomew, Radcliffe College, William Randal Bell, Rensselaer Polytechnic Institute, Philip Berkowitz, Washington Square College, Charles J Cavanaugh, Louisiana College, University of Tennessee, Adele I Cohen, Washington Square College, New York University, Lester L Coleman Cornell College, Ethel A Glancy, Bryn Mawr College, Joseph W Jailer, College of the City of New York, John W Remington, College of Charleston, Gerald B Russell, Lebanon Valley College and Robert C Warner, California Institute of Technology These appointments are for the academic year 1935–36 at $1,000 each

THE David Dunlap Observatory, containing the second largest astronomical telescope in the world, was opened officially on May 31 The observatory and its equipment are the gift of Mrs Jessie Donalda Dunlap to the University of Toronto as a memorial to her husband The mirror for the telescope was moulded at Corning, N Y, and ground and polished in England It consists of a solid block of glass seventy six inches in diameter, about a foot thick and it weighs close to 5 000 pounds The mounting in which it is set weighs upwards of thirty tons The observatory, which is about fifteen miles from Toronto, will be open to the public It is second in size only to Mount Wilson Observatory Dr C A Chant, professor of astrophysics at the University of Toronto, will be director His assistant will be Dr Reynold K Young, professor of astronomy at the university

AN agreement has been reached between the Ohio Wesleyan University and the Ohio State University for the joint operation and use of Perkins Observatory Both contribute toward the observatory budget The director of the observatory will be appointed by the joint action of the Boards of Trustees of both institutions and its management is in the hands of a committee in which both universities are equally represented This agreement contemplates an extension of research and general educational work

THE present research program of the Basic Science Research Laboratory of the University of Cincinnati will be discontinued about July 1 After that time, the work will be continued under the auspices of a new foundation for scientific research, the Institutum Divi Thomae Dr Sperti, director of the Basic Science Research Laboratory, and his research colleagues will transfer to the new institute In addition to scientific research, the institutum plans a broad teaching program, which will be inaugurated in September with the establishment of a course in biophysics at Dayton University

A HABITAT group of elephant seals, shown amid a reproduction of a typical scene on Guadalupe Island off the west coast of Mexico, has been completed at the Field Museum of Natural History The specimens were collected by a special expedition conducted for the museum by Captain G Allan Hancock, of Los Angeles Calif aboard the *Velero III*, which he has especially equipped for scientific work Members of the expedition included Dr Harry M Wegeforth, president of the San Diego Zoological Society, and Julius Friesser and Frank C Wonder, members of the taxidermy staff of the musum

A NEW five year cooperative course in mechanical engineering, leading to the degree of master of science, will open next month at the Massachusetts Institute of Technology, under the direction of Professor Jerome C Hunsaker The new course, which is designed to give students an insight into the technical and executive aspects of industrial manufacture, will be given in cooperation with the General Electric Company Under the cooperative plan, which is similar to that successfully operated for several years past by the department of electrical engineering, students will carry on practical work in the company's plants in conjunction with their studies at the institute The content of the first four years of the course will be essentially the same as that given in the present course in mechanical engineering, there being no omissions in the fundamental and professional subjects Those subjects omitted from the regular course curriculum have their counterparts in the program at the works The final year of graduate study and research will be planned for each student in accordance with the requirements of the graduate school During the final term students may be assigned to the company's research departments for special work designed to develop individual aptitudes Students will be chosen for the new option on the basis of aptitude and scholastic records after two years' study in the regular mechanical engineering course The subsequent three years, including summers, will be spent either at Technology or at the industrial plants. The course will lead to the degree of master of science, together with the degree of bachelor of science as of the preceding year

DISCUSSION

A KITCHEN MIDDENS WITH BONES OF EXTINCT ANIMALS IN THE UPPER LAKES AREA[1]

RECENT evidence of ancient man associated with extinct bison has been found this winter in the drainage of the St Croix River—which river for a considerable distance is the boundary between Minnesota and Wisconsin

October 28, 1934, a farmer brought to the University of Minnesota some large bison bones which he had recently found in a bog occupying an old lake bed on his farm Since then some 1 500 bones mostly bison have been recovered from the deposit The bones were found at an as yet undetermined depth of from 10 to 18 feet below the surface of the bog in a deep marl bed covered by three feet of peat A few bones of elk and caribou were in the deposit, but most of the bones are of a large horned bison determined as *Bison oliver hayi* Figgins[2] No bones of *Bison bison* have been found The bones now recovered represent at least 40 individuals Most of them are of young animals ranging from calves to those of three years But remains of at least six adults also have been secured Many of the bones show that they were food refuse Cuts and scratches made as by flint implements are present on some 20 per cent or more of the bones A few of the recovered specimens are broken as if to extract the marrow Several have been burned Nearly all the bones are in excellent preservation even some of the rib cartilages are preserved

A small number of artifacts as well as the many bones have been recovered These include a few artifacts made of elk and bison bones one artifact of oak wood and a few of stone The artifacts are quite unlike those associated with modern North American Indians in the area

Many sticks and small logs cut by beavers were found in one part of the deposit Like the bones they are in an excellent state of preservation The wood is largely oak, although some fragments of alder and willow were also found

The age of this kitchen middens deposit in the marl has not been determined The marl lies on red drift of the Wisconsin glacier The succeeding young gray drift of the Wisconsin glacier, the last phase of the Wisconsin, stopped some five miles short of the site We also call attention to the fact that bison bones of similar measurements, now in the U S National Museum, were found under 6 feet of peat on Wisconsin red drift at Crosby, Minnesota, in 1923 Those bones were described by the late Oliver P Hay[3] as *Bison occidentalis* Lucas From his description on page 2 we quote as follows We can be certain therefore that *Bison occidentalis* lived in Minnesota until the middle of the last glacial age How much longer we can not now determine" Hence the problem of ancient man in late glacial time or early post glacial time is again thrust into our faces by this new find in the area of the Upper Lakes

Post note As this notice was about to be mailed to the editor of SCIENCE a copy of *The American Anthropologist* for April June, 1935 came to hand with Dr Schultz s article on the Scottsbluff bison quarry Because the extinct bison in said quarry is the same as that in the St Croix marl bed we add a statement regarding the antiquity of the Scottsbluff site from the closing paragraph of Schultz s important article

it would seem that to propose a late Pleistocene dating for this site is not too radical Though many puzzling facts remain to be interpreted and future work in this area will undoubtedly permit the drawing of less tentative conclusions the writers feel confident that such a dating will not prove to be far wrong, and, if modified is much more likely to be extended downward than upward[4] (p 318)

SAMUEL EDDY
ALBERT ERNEST JENKS
UNIVERSITY OF MINNESOTA

[1] A preliminary notice

[2] J D Figgins, *Proceedings of the Colorado Museum of Natural History*, Vol XII, No 4, pp 16–42, December 5, 1933

[3] Oliver P Hay, *Proceedings of the U S National Museum* Vol 63, Art 5, pp 1–8

[4] C Bertrand Schultz and Loren Eiseley, *The American Anthropologist*, New Series, April–June, 1935, Vol 37, No 2, Part I, pp 306–319

STUDIES OF CRYSTALLINE VITAMIN B_1 VII ITS RELATION TO PATHOLOGICAL STATES

SUPPLIES of crystalline vitamin B_1 obtained by a recently developed method[1] offered the possibility of clinical trial of this material Confirmation of the anti neuritic activity of the crystals was obtained by treatment of thirteen cases of human beriberi through the cooperation of A J Hermano in Manila, Philippine Islands

Rats on a vitamin B_1 free, but otherwise supposedly complete diet show complete freedom from polyneuritis with amounts as low as 1 2γ of the crystals per day, but the growth is slight Increase of the vitamin dosage even up to approximately 100 times that necessary for prevention of paralytic symptoms effects increasingly greater weight gains Evidently gross B_1 insufficiency is possible without manifestations of polyneuritis

These results suggest that similar insufficiencies may be present in man due to inadequate diets, idiosyn

[1] R. R. Williams, R. E Waterman and J C Keresztesy, *Jour Amer Chem. Soc*, 56 1187, 1934

crasies of the individual or to temporary derangement of the metabolism giving rise to pathological states not recognizably associated with beriberi. To appraise this possibility we enlisted as medical associate Dr. Martin G. Vorhaus. Clinical trials have been made in polyneuritis of pregnancy, colitis, nutritional edema, gastro-intestinal atony, polyneuritis of undiagnosed origin, etc., as indicated in part elsewhere.[2] Study of these conditions is being extended with gratifying results.

Considerable evidence also exists as to a relationship between vitamin B_1 and carbohydrate metabolism.[3] In view of this the effect of the administration of large amounts of the pure vitamin in human diabetes is being studied. The early results are extremely interesting and give further evidence of the significance of B_1 in metabolism and its possible therapeutic use in cases of deranged carbohydrate utilization. When these results have more fully matured they will be reported by Dr. Vorhaus and collaborators through the usual medical channels.

We wish to express our gratitude for financial aid from the Carnegie Corporation through the Carnegie Institution of Washington.

Robert R. Williams
Robert E. Waterman
John C. Keresztesy

463 West Street,
New York, N. Y.

A PHYTOSTEROL AND PHYTOSTEROLIN FROM THE SWEET POTATO

During the process of isolation of carotene from the sweet potato *Ipomoea Batatas* Poir., a phytosterol and a phytosterol glucoside or phytosterolin were separated. Since these substances have not been previously reported from this source, it seems desirable to record them in the literature.

The phytosterolin was separated from a concentrated solution of the sweet potato pigment before saponification, and the phytosterol was removed from a concentrated extract of the material remaining unsaponified by alcoholic potassium hydroxide.

After repeated recrystallization of the crude phytosterolin from dilute pyridine it melted at 285° to 286° and gave an acetate melting at 165° to 165.5°. With careful manipulation a positive Salkowski sterol reaction and an alpha naphthol test for carbohydrate were obtained on the parent substance.

After two recrystallizations of the phytosterol from ethyl alcohol-ethyl acetate mixture it melted at 136.5° to 137° and gave both the Liebermann-Burchard and Salkowski reactions for sterols. On treatment with acetic anhydride an acetate was formed which melted at 129° to 129.5°.

From these data it is concluded that the phytosterol of the sweet potato consists chiefly of sitosterol and that the phytosterolin is a sitosterol glucoside.

M. B. Matlack

Bureau of Chemistry
and Soils

THE APPLICATION OF ARTIFICIALLY IONIZED AIR

In the first volume of transactions from the Central Laboratory for Scientific Research on Ionification, entitled "Problems of Ionification," and edited by Professor A. L. Tchijevsky,[1] is presented an extensive review of the theory of ionization, the general biological influence of ionization on animals and the results of experimental ionization of chickens.

The ionization of air (or the accumulation of negatively charged particles in the air) has been done by the use of high-potential, 100,000 volts, 0.5 milliampere, frequency at least 3,000 cycles per second electric current, transformed from the original source of 110–220 volts D.C. This has been considered as one of the cheapest and the most convenient methods of artificial ionization of air on a large scale. There were produced from about 400,000 to 600,000 negatively charged particles per cm^3 (as compared with ordinary air, which has about 2,000) by brush discharge ("electrofluvial luster") from the negative electrode suspended from the ceiling at a distance of about 3½ feet from the floor, or about 35 cm from the layer of treated eggs.

The experimental results on the influence of ionized air on the chicks and mature birds, as well as on the eggs during the incubation, though they were obtained under highly unfavorable experimental conditions and with a low quality of experimental material, in most cases were very significant and convincing.

On the basis of these experiments as well as in the consideration of the studies presented in Volumes II, III and IV, on other domesticated and wild animals, insects, bacteria, plants, seeds, etc., it was concluded that ionized air prevents weak individuals from early death, increases the growth of birds and their productiveness (egg laying), helps to assimilate food, increases general metabolism, raises physical activity, improves reproduction, favorably affects the composition of blood, increases the resistance of an organism and has preventive and therapeutic value in some diseases (such as avian tuberculosis). From these one can see a definite biological influence of ionized air,

[2] Carnegie Inst. Year Book, No. 33, 297, 1934.

[3] M. Labbe, F. Nepveux and J. D. Gringoire, *Bull. Acad. Med.*, 109: 689, 1933; C. A. Mills, *Am. Jour. Med. Sci.*, 175: 376, 1928.

[1] A. L. Tchijevsky, *et als.* "Problems of Ionification," I: 1–487, Voronezh, U. S. S. R., 1933 (in Russian).

its prophylactic value, and possibly its wide application for promotion of the health, vigor and increase of economic value of birds, particularly under certain unfavorable climatic conditions or during winter months.

However, these results are far from final. At present it is even impossible to predict with appreciable accuracy the prophylactic, therapeutic or economic application of this method in poultry production. More thorough work under well-controlled conditions is needed towards the evaluation of the exact influence of other factors involved in this method of ionization of air, such as production of ozone, nitrous compounds and possibly thermal effect, presence of ultra-violet, x-rays, etc., and then the standardization of ionic concentration, doses and duration of exposure of birds of various ages and physical state of health.

In general, the initiative of Professor Tchijevsky and his co-workers is of significant biological interest. It may serve as an inspiration to those who wish to attack the problem and to get some definite and perhaps useful results. There are many possibilities, however, not only in animal production but in various fields of animal and plant economic biology. Moreover, it suggests a wide field of research in relation to medicine, preventive and curative.

ALEXIS L. ROMANOFF
CORNELL UNIVERSITY

EXPERIMENTAL ADAPTATION OF FRESH-WATER CILIATES TO SEA WATER

YOCOM[1] maintains that he has not been able to find any record of an attempt to adapt fresh-water ciliates to sea water. He obviously overlooked Finley's paper. Finley[2] asserts that he tested fifty species of fresh-water protozoa and that he succeeded in adapting twenty of them, including *Paramecium aurelia* and *Paramecium caudatum*, to pure sea water, with no significant change in the morphology and only a "relatively slower pulsation of the contractile vacuoles."

I have repeated Finley's experiment several times, using *Paramecium caudatum* and *Paramecium multimicronucleatum*, but I was unable to confirm his contention. The animals always died when the concentration of sea water approached 40 per cent. There were also marked changes in the morphology of the animals, and there was a marked decrease in the frequency of the pulsations of the contractile vacuoles. I hope to publish a more detailed account of these experiments in the near future.

JOHN A. FRISCH, S.J.
ZOOLOGICAL LABORATORY
JOHNS HOPKINS UNIVERSITY
AND
LOYOLA COLLEGE, BALTIMORE

DISTRIBUTION OF SEPARATES OF CERTAIN PAPERS BY THE LATE DR. BASHFORD DEAN

THERE have been placed in my hands, by Mrs. Bashford Dean, for distribution among students of fishes, certain reprints of Dr. Dean's studies on the archaic fishes, found among his effects after his untimely death.

If research men who are interested in the morphology, anatomy and embryology of the cyclostomes, sharks and ganoids will go through Dr. Dean's bibliography either in Vol. 1 of the "Bibliography of Fishes" or in Art. 1 of the Bashford Dean Memorial Volume, and will indicate to me what articles they desire, I will forward these so far as they are available.

It may be some time before the actual sending out can be done, but I should like to have all requests in before the distribution is begun.

E. W. GUDGER
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK, N. Y.

SCIENTIFIC BOOKS

PRIMITIVE LAND PLANTS

Primitive Land Plants, also known as the Archegoniatae. By F. O. BOWER. Macmillan, London, xi + 658 pp. 465 ill. Price, $8.00.

PROFESSOR BOWER may be said to have devoted a long life of research chiefly to those plants collectively known as the Archegoniates, that is, to the mosses, liverworts, ferns and so-called fern-allies—the club-mosses and horsetails. Any intelligent person working in this field would naturally be much concerned with the beginnings of land floras, and Bower published "The Origin of a Land Flora" in 1908. Since then he has summarized his work on "The Ferns" in three important volumes (1923–1928) and formulated his ideas on "Size and Form in Plants" in a stimulating work (1930).

Meanwhile there has been a notable accumulation of additional facts regarding both living and fossil Archegoniates—especially the recognition of the Devonian group Psilophytales. These discoveries have served to draw together the Bryophyta, Pteridophyta, Lepidophyta and Arthrophyta, and, it seems to me, put an end for all time to notions that the earliest land plants were polyphletic transmigrants of Algae. Bower now returns to the origin of land plants in

[1] Harry B. Yocom, *Biol. Bull.*, 67: 273–276, 1934.
[2] Harold Eugene Finley, *Ecology*, 11: 337–347, 1930.

what is essentially a new book and in my opinion a much better book—better not only because of the greater amount of factual knowledge available for the discussion, but better for the ripened point of view and the emphasis placed on size and form and function—that is organographic rather than purely morphological.

The main plan of the present work may be stated briefly. The first 23 chapters are devoted to a factual account of what is known of the several classes of Archegoniates. The next six treat features common to all, such as alternation, embryology, conducting system, etc., followed by a chapter devoted to comparative organographic analysis, and a final chapter summarizing the results, which are hence mainly inductive. The work is in no sense an attempt to unravel phylogenetic relations but is an effort to visualize stages by the method of comparative morphology.

The stated foundation of the work is the alternation of generations, and the invariable alibi for inconvenient facts is homoplasy. Obviously, space does not permit detailed comment on this notable work and many aspects and conclusions must be passed over. Bower considers the alternation of generations as tied up with the occupation of the land. He considers this opinion to have safely survived the shock of the discovery of apogamy and apospory, but is bound to admit that the cytological basis for alternation which seemed to result from Strasburger's discovery of the doubling of chromosomes in syngamy and halving their number in meiosis or reduction breaks down among the Algae. In this great group, although some behave like normal land plants, others show no relation between the nuclear cycle and the somatic cycle, and even among the Archegoniates gametophytes may be diploid and sporophytes haploid. Only by considering instances of the last kind as ruled out by their infrequency and the standardized reverse as the significant can the theory proceed logically.

In contrast with the rigid morphology of, say Sachs's 1875 text, where the plant body is divided into caulome, phyllome, rhizome and trichome, Bower adopts Zimmerman's recent concept of the "telome" as the unit of the shoot and therefore primary.

Earliest land plants had indeterminate dichotomizing branch systems not differentiated into axis and leaf. This differentiation into axis and cladode leaves followed in the same manner as the development of lateral pinnae on a rachis in a dichotomizing fern leaf. Bower states that the investigation of the Rhynie plants in 1917 validated this idea. It may seem ungracious to point out that Dawson as early as 1859 had furnished sufficient evidence for this idea in his account of Psilophyton. The reason it was passed over was, of course, that a plant morphologist sees nothing that can not be viewed through a microscope.

The other morphological unit is the "enations," that is, new formations on a surface previously untenanted, hence from their beginnings appendages and borne laterally on a pre-existing part. They are thus secondary and not primary. Microphyllous leaves are enations, as are the dermal appendages of ferns. If this be accepted it follows that neither the modern Psilotaceae nor the ancient Psilophytales are reduced.

Megaphyllous leaves, on the other hand, as shown by Tansley in 1908, are cladodes formed by webbing of a primitive branch system. They therefore have a common origin with the axis, and the old morphological rigamarole about stem and leaf can be consigned to the limbo of forgotten things, where indeed it belongs.

Apparently influenced by Fritsch's idea that it would be unnatural to have green land plants originate from brown or red algae, and that since the filamentous green Isokontae never reach a massive plant body because the more elaborated members of that group became land plants, Bower looks with favor on this group as a possible source for a land flora, the vascular members of which survived by interpolating between syngamy and meiosis a sporophyte or diplophase, the retardation of meiosis being due to sterilization. This thesis demands the admission that the initial steps of such a process are not observable in any living plants, that apogamy and apospory must be thrown out and the normal considered the real clue, that homology is rare and homoplasy frequent, that the incidence of photosynthesis is variable, that distal fertility is primitive, and that size is the most constant factor in moulding the form of the biont whether diploid or haploid.

Following Campbell and Von Goebel, the Anthocerotales are considered as exemplifying an early synthetic and primitive type. It is conceived that "the inward urge towards increase in size" (whatever that may mean) may take effect in both the diploid and haploid phase, or independently in either. Thus is the difference between the Bryophytes and the balance of the Archegoniates explained—the limited dimensions of the gametophytes in the latter being attributed to "the want of driving power in the haploid phase" (whatever that may mean).

The Devonian genera Rhynia and Hornea show the following improvements over the Bryophyta: (1) physiological independence, (2) forking, (3) dichopody, (4) definite conducting tracts. The genus Thursophyton adds enations and continued apical growth. Such a plant as Asteroxylon is regarded as originating by the bifurcation of a simple telome like

those of the Bryophytes in which dichopodial development and delay of fructification clearly foreshadow either cladode leaves with distal sporangia (*ferns*) or a truss of fertile twigs liable to condensation into a strobilus (lepidophytes and arthrophytes) The bracteate cones of the latter are therefore composite in nature

One wonders if anything but the proverbial provincialism of the British warrants the inclusion in a work of international scope of a chapter on the "Evolutionary Relations of British Ferns" Finally, although Professor Bower makes a consistent case for his ideas in this most stimulating book I can only repeat the doubts which I expressed in 1927 that the middle Devonian structural material on which the present argument leans so heavily may be merely ancient and simple, rather than that it represents a primitive missing link, although I am bound to admit that it has been made to serve such a purpose in a very admirable way

E W BERRY

SUBSIDENCE

Subsidence within the Atmosphere By JEROME NAMIAS Harvard Meteorological Studies No 2, 25 cm × 19 cm, 61 pages Harvard University Press, 1934 Price, $0 85

THIS work is a notable contribution to the very limited amount of literature on the subject of subsidence The paper is divided into two major portions The first is a discussion of subsidence from the general standpoint, and diagrams are presented which are constructed from the aerological material which is discussed synoptically in the second part of the paper The second section gives the salient features in connection with three meteorological situations In the detailed analysis of the aerological material for these periods special emphasis is placed upon the subsidence inversions observed The maps presented contain only the fronts, air masses, isobars, precipitation areas and positions of aerological stations The aerological diagrams provide a continuity in the sequence of the weather over the 24 hour intervals represented by the maps Cold fronts are shown as heavy black lines, warm fronts by double light lines and occluded fronts by broken heavy lines The air mass notation is that introduced in this country by the meteorological course of the Massachusetts Institute of Technology

As a mass of cold air (Pc) moves southeastward from the polar regions over North America it spreads out laterally at the surface, and this spreading is probably balanced by a general sinking of the air mass. Subsidence is a stabilizing process which takes place primarily at the upper levels in the atmosphere, and obviously must be non-existent at the surface of the earth Day to-day aerological soundings made within one and the same polar air mass often show that not only stabilizing forces are at work, but also sharp inversions develop These inversions are generally associated with a sharp drop in relative humidity through the inversion, and not infrequently there is a marked drop in the specific humidity The author claims that the subsidence inversion can generally be distinguished from the frontal (*i e* change of air mass by advection) inversion by means of the moisture discontinuity, since the inversions accompanying fronts almost always have an appreciable increase in the specific humidity upward through the inversion While this criterion of specific humidity for the differentiation between frontal and subsidence inversions generally holds it should be pointed out that there are cases when a warm front surface may superficially appear as a surface of subsidence but the author claims, the opposite case, that of mistaking a subsidence inversion for a frontal inversion, is more common This error can generally be blamed on the hair hygrometer, since it is well known that the hair behaves erratically under certain conditions and has a particularly large lag coefficient at low temperatures and at low relative humidities

The temperature and moisture discontinuities through these inversions often are so pronounced that it is necessary to assume that there are other contributing factors in addition to subsidence which are tending to sharpen the inversion Indeed, even the problem of the original development of these temperature inversions is not yet clear

The compensating subsidence due to the outflow of air in anticyclones which takes place across the surface isobars because of the frictional effect in the lower layers can not account for the rapid development of subsidence inversions observed in many of our rapidly moving anticyclones of the winter season Georgii in 1920 showed that the surfaces of subsidence are not horizontal but present a slope It is generally smaller than that of either the warm or the cold front It now seems clear that these surfaces of subsidence are extensive domes which may at times reach beyond the 5 kilometer level and at times practically intersect the surface of the earth along their periphery An example of a subsidence dome in its embryonic stage and later in its development has been given by the author in a previous paper The difficulty in determining the topography of the subsidence domes should be simplified with the recent increase in the number of aerological (airplane) stations throughout the United States

Potential temperature is considered a conservative meteorological element because it remains constant during an adiabatic process with unsaturated air

After a subsidence dome is once established, the air above the surface of the dome sinks and spreads. At upper levels in the atmosphere, where the effects of turbulent exchange and radiation are small, the process is adiabatic—the potential temperature of each subsiding particle of air remaining constant. A discontinuity of lapse rate within the atmosphere guides the vertical flow of air, since the isotherms of potential temperature represent stream lines of flow. This is evident from the principles of stability. Any horizontal relative movements of the air particles on either side of the inversion will thus be along the particular potential isothermal surfaces on which they lie. The tendency, then, is to maintain a constant potential temperature at the base and top of the inversion. However, small variations do occur, and they may be accounted for by three factors that tend to produce variations in the potential temperature along the surface of subsidence, namely, (1) divergence (and convergence) above and below the inversion, (2) radiation and (3) turbulence.

This comprehensive paper on subsidence should be read carefully by all meteorologists.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW ARRANGEMENT FOR REGULATING FLOW OF LIQUID INTO A CULTURE VESSEL

MAINTENANCE of a specified composition of liquid medium in a culture vessel, as for solution culture experiments with plants, may be satisfactorily accomplished only through employment of some device by which fresh liquid is allowed to flow continuously into the vessel at a suitable rate, with a like rate of waste discharge. This was first emphasized by Trelease and Livingston.[1] Unknown and unpredictable effects of differential absorption by the cultured organisms are thus avoided, as are also the effects of accumulation of substances or ions extruded by the organisms or produced in the vessel. One needs to be able to increase or decrease the rate of flow at will. It should be but little more rapid than is necessary and it needs to be automatically maintained for long periods.

Continuous-flow plant cultures were used by Nobbe as early as 1865,[2] and Schloesing[3] employed an automatic intermittent renewal of solution in some of his experiments. Continuous flow has been increasingly employed for solution cultures and sand cultures of plants since the appearance of Trelease and Livingston's paper; more recent writers on this sort of experimental technique are: Allison and Shive,[4] Prianischnikow,[5] Johnston,[6] Shive and Stahl,[7] Pirschle,[8] Zurbicki,[9] Zinzadze,[10] Pierce,[11] Ungerer,[12] Mehrlich,[13] Trelease and Thompson.[14] Some of these give additional references. Several arrangements for the control of solution flow have been shown at recent annual science exhibitions of the American Association, by Dr. J. W. Shive and by Dr. Sam F. Trelease.

From a comparative study of many different arrangements, the writer has developed the new form of simple continuous-flow apparatus to be described in the present paper, in the preparation of which he has had the benefit of valuable criticism and cooperative help from Professor Burton E. Livingston, Mr. W. Luther Norem, Dr. Theo. C. Scheffer and Mr. Karl A. Grossenbacher, all of this laboratory.

The rate of flow of a liquid through a small orifice is determined partly by the viscosity of the moving liquid within the orifice, partly by the hydrostatic-pressure difference between the entrance and exit of the orifice, and partly by the resistance introduced by the orifice walls. The viscosity of a stable liquid nutrient medium may be satisfactorily maintained by keeping its temperature nearly constant, but this consideration of temperature influence has apparently not yet received attention in the present connection.[15]

The hydrostatic-pressure difference that drives the liquid through the orifice may be satisfactorily maintained if a small constant-level tank is introduced between reservoir and orifice (as in the arrangement of Trelease and Livingston, for example). It is well to equip the reservoir as a Mariotte flask, closed above and with air inlet near the bottom.

This Mariotte arrangement alone, without accessory tank, suffices to maintain a practically constant hydrostatic head excepting that pressure at the entrance to the orifice is somewhat excessive during periods when the temperature of the confined air in the reservoir is rising. For any combination of orifice resistance

1 SCIENCE, 55: 483–486, 1922.
2 *Landw. Versuchst.*, 7: 68–73.
3 *Ann. Sci. Agron.*, 1: 315–359, 1899.
4 *Amer. Jour. Bot.*, 10: 554–566, 1923.
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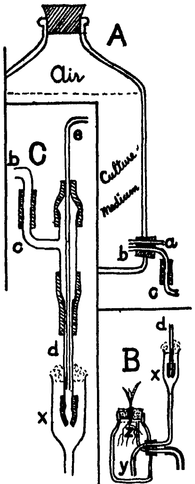

FIG. 1

and liquid viscosity, the rate of delivery is more or less excessive during such periods. In the arrangement described below this source of fluctuation is practically avoided without recourse to a constant-level tank.

The most satisfactory orifice previously used is simply a short length of suitable capillary glass tubing, but with such orifices clogging may result from trapping of undissolved particles[16] and orifice resistance can be changed only by stopping the flow, removing the capillary tube and replacing it with another one that offers the desired resistance. The new annular orifice is readily adjustable for different degrees of resistance without interrupting liquid flow, and it is not so apt to become clogged as other orifices.

A readily adjustable annular orifice, for either gas or liquid, was described by Gregory,[17] to whose paper the writer is indebted. It is simply the narrow space between two concentric glass tubes, the bore of the outer tube being but little greater than the external diameter of the inner one. The flowing liquid passes between the tubes. Resistance to flow is of course determined partly by the mean distance between the tubes and partly by the length of the annular space. The latter is easily adjusted by sliding the inner tube or plunger within the outer one.

The essentials of the writer's arrangement are shown in the diagrams of the accompanying figure, where, for the sake of clearness the orifice parts (C) are drawn on a larger scale than the other parts (A, B). The supply reservoir (A) is a 5-gallon glass bottle with a lateral shop-drilled perforation (25 mm in diameter) near the base. (Bottles and jars have been drilled at the Johns Hopkins University shop, at a cost of about 25 cents per perforation.) The mouth is regularly tightly closed with a rubber stopper. In the perforation is a 2-hole rubber stopper bearing two glass tubes. Tube *a* admits air in small bubbles, as the liquid level descends. When the bottle is opened, for refilling, the outer end of this tube is temporarily closed by means of a bit of rubber tubing with its outer end plugged. If the air pressure above the liquid in the reservoir tends to become excessive through rising temperature, pressure excess is promptly relieved by slowing down or cessation of air entrance and, in extreme cases, by the escape of some liquid through tube *a*. Such escape of liquid occurs only with pronounced and rapid temperature rise, especially when the air space in the reservoir is large. Liquid thus escaping may be caught in a small vessel. (Tube *a* may be at the side of tube *b* rather than above it and its outer part may be bent to one side. It should be slightly bent downward at its outer end.) Any slight decrease in the air pressure above the liquid (as by falling of temperature) causes air to enter somewhat more rapidly than liquid is passing out through the orifice, consequently such pressure decrease can not become significant. Alterations in the barometric pressure of the surrounding atmosphere would be similarly cared for if considerable.

The outlet tube is joined to the lateral arm of the 3-way tube *c*, the main part of which is vertical and has a bore of about 7 mm. The outer tube *d* of the annular orifice has a bore of about 5 mm and is about 10 cm long. It is attached, by means of a short rubber coupling, to the lower end of *c*. The inner tube or plunger (*e*) is about 20 cm long, being selected to fit closely within the outer tube but to slide freely. It extends up through and beyond the vertical part of *c*, the annular opening between them being closed above by means of a bit of non-adhesive rubber tub-

[15] See Christiansen, Veihmeyer and Givan, *Ecol.*, 11: 161–169, 1930.

[16] Johnston and Livingston, *Plant World*, 19: 136–140, 1916.

[17] *Ann. Bot.*, 47: 427–428, 1933.

ing, through which the plunger may be raised or lowered to increase or decrease orifice resistance At the lower end of the outer orifice tube (*d*) is a short bit of rubber tubing, into which the plunger tip fits when completely depressed, to close the orifice The lower end of the plunger tube need not be sealed, but a suitable glass rod serves as well as a tube

Liquid dripping from the orifice is caught in the funnel (*x*) and conducted to the culture jar through tube *y* The opening around tube *d* in the funnel mouth should be closed, as with a cotton plug to retard evaporation and exclude dust The jar (of the "Mason" pattern) has a shop drilled lateral perforation (25 mm in diameter) that bears a 2 hole rubber stopper and two tubes (*y*, *z*) The inner end of the supply tube (*y*) is bent downward, extending nearly to the bottom of the jar, while the overflow tube (*z*) is correspondingly bent upward, so as to terminate at the level where the free liquid surface in the jar is to be maintained To the outer end of *z* is attached a rubber tube leading to a waste receptacle The rate of withdrawal of liquid from the reservoir may be roughly estimated by observing the rate of bubble formation at the inner end of tube *a*, and the rate of discharge at the orifice may be ascertained by observing either the drip into the funnel or the rate of waste discharge

This sort of annular orifice, whose details may be altered in many ways, may be used in connection with any form of reservoir that maintains a constant hydrostatic pressure at the orifice entrance, as with the reservoir of Shive and Stahl or with that of Johnston, for example Several orifices, with resistances that are either alike or different, may operate from the same reservoir

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SPECIAL ARTICLES

A SECOND-GENERATION CAPTIVE-BORN CHIMPANZEE[1]

CHIMPANZEES of definitely known ancestry, birth date and life history, with the exception of fourteen in the breeding colony of the Yale Anthropoid Experiment Station in Florida, are rare indeed, and of second generation births in captivity the first is now to be reported

On April 11, 1935, a full term, healthy male infant was born at the station to a primiparous female, whose distinction it is to be the first chimpanzee of known birth date and history to mature sexually and to reproduce under scientific observation The maternal grandparents as well as the parents of this second generation infant are living and belong to the station colony The new arrival has been named Peter, his number in the laboratory records is 41

So far as known, the ancestral history of Peter reads as follows His maternal grandfather Jim and his grandmother Mona, whose hypothetical birth dates are 1900 and 1913, respectively, were known to the writer for many years as members of the Abreu primate collection in Havana His father Bokar, whose hypothetical birth date is 1925, was brought to the station from French Guinea in 1930 by Dr Henry W Nissen of the staff His mother Cuba, daughter of Jim and Mona, was born in Havana on March 24, 1926 Jim, Mona and Cuba, among other chimpanzees, were presented to the Yale Anthropoid Experiment Station by Pierre Abreu in May, 1931 [2]

Of the four known and living ancestors of Peter, Cuba alone is of dated birth and reliably recorded developmental history She first exhibited characteristic genital swelling in April, 1933 Menstrual bleeding occurred first on July 10, 1933, when she was seven years, four months, old She was caged with a mature male from May, 1933, and she became pregnant August 9 ($\pm$ 5 days), 1934, at the age of eight years, five months

These observations are unique in that, for the first time in the history of biology, they establish the age of a chimpanzee at sexual maturation and first impregnation

Cuba's gestation continued for 245 $\pm$ 5 days It was uneventful Parturition was normal and easy, although accompanied by an exceptionally great loss of blood Delivery must have occurred about 3 P M, on April 11, 1935 It was not observed According to Mr M I Tomilin, Cuba showed no signs of discomfort or of the near approach of parturition at 2 10 P M At 3 20 P M the outcries of an infant in a cage adjoining Cuba's attracted Mr Tomilin's attention, and the newborn infant Peter was discovered His mother was then eating the afterbirth This was completed, and she later drank much of the fluid, mostly blood, on the floor of the cage

Mother and infant were observed continuously from 3 20 to 4 10 P M, and both verbal and pictorial records were made of their behavior As primiparous

[1] The following have contributed to the life history records upon which this report is based Mrs Rosalia Abreu Messrs Pierre Abreu, O L. Tinklepaugh, K W Spence, J H Elder and M I Tomilin

[2] As Jim, then considered an old male, was not needed at the station as a breeder, he was presented to the Philadelphia Zoological Garden for use until death as an exhibition specimen.

mother Cuba exhibited behavioral inadequacies Al though from the first she carried Peter about with her, holding him awkwardly, usually grasped in one hand, she did not, according to species practice, place him upon her abdomen or breast and permit him to cling to her Instead she treated him much as she might any strange object which interested, puzzled and annoyed her Toward the end of the period of observation she forcibly broke his hold upon her whenever he suc ceeded in grasping her hair or skin with hand or foot Often in so doing she was rough and impatient and vocalized complainingly

Peter was left with his mother for about eighteen hours (overnight) under intermittent observation As Cuba did not accept him to be nursed and generally cared for, it was necessary to take him from her, in order that he might not become the victim of her inexperience, curiosity, neglect or abuse

A few days prior to parturition Cuba had been observed by the writer to strip colostrum from her right nipple and to eat it No evidences of lactation were observed following parturition The mother was not markedly disturbed when separated from her in fant by the closing of a slide door between cage and living room Although fatigued by parturitional effort and weak from loss of blood, she speedily recovered and in a few days appeared entirely normal When taken from his mother eighteen hours after birth Peter weighed 1 61 kg Presumably his birth weight must have been close to 4 lbs (1 81 kg) He was perfectly formed, strong, healthy, fed readily from a bottle and throve from the first on a mixture of irradiated evaporated milk, corn syrup, lemon juice and water

This is the prolegomenon to a story, which it will require decades to complete, whose plot features the breeding and other shaping of chimpanzee to specifica tion and its standardization for use as material of biological research Instead of keeping the animal as it comes from the wild, we purpose to fashion it to maximal usefulness as experimental object To this end, modification in accordance with specification formula and relative standardization are deemed essen tial For each of the forty chimpanzees which to day constitute the distinctive resource of this establishment for biological inquiry, an inclusive life-history record is continuously kept Within a few years there will not—or at least need not—be an individual in the colony whose ancestry, birth-date, developmental and experimental history are not matters of reliable record and of steadily increasing value These are among the objectives which we present as excuse for this an nouncement to the scientific world of the birth of a second generation captive-born chimpanzee

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A GENE FOR CONTROL OF INTERSTITIAL LOCALIZATION OF CHIASMATA IN ALLIUM FISTULOSUM L

CYTOLOGICAL investigations in Allium were begun at Davis, California, in 1931 A fact worthy of a preliminary report is the evidence that the interstitial localization of chiasmata at IM in *A fistulosum* is probably controlled by a recessive gene In the cor responding stage of meiosis in *A cepa* the chiasmata are all terminal This results in configurations of two types—rings and rods The ratio between the two types varies from cell to cell instances of all rings or rods occurring with all possible grades be- tween Very probably, rods simply represent the earlier separation of two ends

A hybrid between *A cepa* and *A fistulosum* was secured in 1931 It was exceedingly regular in meio sis, and a study of late IM showed the bivalents to be practically identical with those in the same stage in *A cepa* The configurations appear slightly different from those of *A cepa* but these deviations probably result from inversions and other changes in gene arrangement in the chromosomes of the two species In no instances were any bivalents found in which the chiasmata were localized at the constriction region

As a part of our general investigation of this hy brid, backcrosses were made in 1933 to both *cepa* and *fistulosum* Those backcrosses to *fistulosum* bloomed this year, whereas those backcrossed to *cepa* behaved as biennials and will not bloom until next year Table 1 summarizes some of our studies As there were only seventeen plants in the population, any con

TABLE 1

BEHAVIOR OF PLANTS IN BACKCROSS POPULATION

Plant No	Type of chiasmata	Per cent of meiotic abnor malities	Per cent of good pollen	Number of seeds per umbel
2–8	Interstitial	0 00	67 0	292 00
2–3	"	0 00	96 9	231 25
1–1	"	5 50	97 9	205 50
2–4	"	0 00	75 9	122 00
2–7	"	3 55	95 2	114 23
1–2	"	3 19	97 3	88 70
2–5	"	1 88	97 0	66 56
2–2	"	1 69	56 0	51 44
1–6	"	3 77	47 2	22 14
2–9	"	0 00	98 7	13 00
2–1	Terminal	21 10	76 6	8 20
2–10	"	18 51	93 2	5 85
1–4	"	35 48	92 8	5 76
2–6	"	1 81	91 3	5 61
1–7	"	0 00	95 6	1 20
1–5	"	8 16	99 3	0 17
1–3	"	31 57	75 9	0 06

clusions drawn from the data must be made with caution. Ten of the seventeen plants had interstitial chiasmata, and the remaining seven were terminal. The plants have been arranged in the order of their fertility; and coincidence will probably not explain why the most fertile all had localized chiasmata. The third column depicts the situation as to chromosome pairing at IM. The cells examined in each plant exceed fifty. The two most fertile plants were devoid of irregularities, but so was one of the most sterile. Another interesting matter is the complete lack of correlation between per cent. of good pollen and fertility. The most fertile plant has 67 per cent. good pollen, and the next to the most sterile had 99.3 per cent. There are fertile plants with a high per cent. of good pollen, and others with a low per cent. This is equally true of the more sterile plants.

The temptation is strong to state that type of chiasmata in each species is gene controlled. If this is true, the ten plants showing interstitial chiasmata should all be homozygous recessives, and all their progeny should have bivalents with interstitial chiasmata. The seven plants with terminal chiasmata should all be heterozygous, and their progeny should segregate for terminal and interstitial. Populations from each of the seventeen plants are now in the seedling stage, and next spring a large number of each will be examined.

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HOW LONG DO ROOTS OF GRASSES LIVE?

ROOTS have been investigated much less than the above-ground parts of the plant because their study necessitates much more difficult technique due to their inaccessibility. As a result the length of life of both seminal and nodal roots remains a disputed question. Many earlier botanists suggested that the seminal root served to supply the plant only for a few weeks prior to the growth of nodal roots. Later workers showed that the seminal root served throughout life in annual grain plants. No work is known to the writer which concerns the length of life for either type of root in perennial grasses.

In 1932 Dr. J. E. Weaver, of the University of Nebraska, suggested to the writer the possibility of placing permanent marked bands on roots as a means of identification for determining life span. This was tried on a group of typical prairie grasses grown from both seed and rhizomes.

Containers one foot in diameter and three feet in depth were fitted with a removable metal collar extending about 4 inches above the top. The soil, therefore, extended well above the top of the container and, by removing the collar, the upper part of the roots could easily be exposed by gently washing or picking the loose sandy soil away. A small aluminum band about one fourth inch wide was stamped with a number and bent around each individual root about two inches below the soil surface. The plants were examined every six months for two years. They were subjected to all degrees of soil moisture from below the wilting coefficient to saturation, and to temperatures of 0° F. to 112° F. The results are shown in Table I.

TABLE I

Species	No. banded	Number of banded roots living			
		6 mo.	12 mo.	18 mo.	24 mo.
Sporobolus heterolepis	5	5	5	4	2
Panicum virgatum	3	3	3	3	3
Bouteloua curtipendula	8	8	8	8	2
Andropogon furcatus	10	10	10	10	6
Stipa spartea	5	5	5	3	0

These results show that in all plants studied a root lives for at least a year and many in excess of two years. Some new roots are produced each season.

Tests made on the seminal roots of *Andropogon furcatus* revealed that all lived to an age of 18 months and some were still functioning at the end of two years. Thus the life span of the seminal root appears to approach, at least, that of the nodal root.

From these preliminary tests it is concluded that the method outlined is very satisfactory for measuring the life span of roots. These tests indicate that both seminal and nodal roots of prairie grasses, even under adverse conditions, may live in excess of two years.

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SCIENCE

VOL. 81 FRIDAY, JUNE 7, 1935 No. 2110

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

NORMAL AND MALIGNANT CELLS[1]

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THIS evening I propose to discuss the proposition that malignant cells are permanently altered cells. They are new types or species of cells that arise in the body from normal, usually adult, cells which have been altered by environmental influences or agents of one sort or another. The alterations appear to be irreversible in the body and in vitro under the ordinary conditions in which the cells live and multiply. It is conceivable that just as normal cells can be converted into malignant cells by an extraordinary environment, so perhaps malignant cells of one type may be changed into other types (of malignant cells) or reconverted into normal cells by a different environment. The pathologists speak of tumors changing. This may be explained either by an alteration of the malignant cell or by the gradual overgrowth of one special type among two or more types that were originally present. After malignant cells are once established they multiply independently of the special environment or agents which produced them, as is amply illustrated by the growth of metastases, by serial transplantations from animal to animal and by serial in vitro cultures. They can multiply indefinitely *in vivo* and *in vitro*. Many are cytologically different, that is visibly different from normal cells of the type from which they arose.

Speculations on the origin of malignant tumors or neoplasms have extended over a long period of years. Advocates, led astray by their own pet theories, have fought for this and that idea. In my student day there came to Baltimore pleaders for the protozoan origin of cancer, and following this a distinguished protozoologist worked out the life history of

[1] Presidential address, read before the American Association of Anatomists, at the St. Louis meeting, April 19, 1935.

cancer producing protozoan Peculiar bodies seen in some carcinoma cells led to this view, but since they are not present in various other types of cancer the idea soon died a natural death

Bacteria have in turn been pushed to the front as the causative agents of cancer Bacteria like protozoa have been eliminated from the race although there are still a few who believe that they can produce malignant tumors The work of Irwin Smith on the tumors in plants produced by the *bacterium tumefaciens* gave an added impetus some years ago to the idea, when it was found that remarkable tumors could be produced in animals with a similar organism recovered from a human breast carcinoma No evidence has appeared that the cells of such growths can multiply indepen dently of the organism and until such evidence is con clusively demonstrated these tumors should not be classified with malignant ones

There are still investigators who maintain that tumors are probably due to viruses They state that viruses may produce every type of cell change from pure necrosis to almost pure cell proliferation They point to a series of virus epithelial tumors ending with non filterable ones and malignant epithelioma and to a series of connective tissue tumors beginning with ones produced by filterable viruses and ending with non filterable fowl and mammalian sarcomas and ask where a line is to be drawn between infectious tumors and so called true tumors or the ones that we would say are not dependent on the presence of any infectious agent for their origin and growth Many attempts have been made to recover viruses from true mam malian tumors and to reproduce the tumors with filtrates but so far without success although claims to the contrary have frequently been made The par ticipation of viruses in the production of what we might term true tumors is not easy to eliminate but a provisional line can be drawn between them The virus tumors can be produced by cell free filtrates but not the malignant ones Some day it may be shown that some of the tumors now considered malignant are in the virus class Another profound difficulty exists in the uncertainty as to the very nature of viruses Are they living organisms or merely chemical substances? But even with this uncertainty we can separate the true tumors from the turmoil by depending on whether cell free material from them will or will not produce the tumors This leaves the famous Rous chicken sar coma on the virus side, where it probably belongs

Although one might explain the multiplication of malignant cells by the presence of a virus which in creases with cell increase it is difficult to understand, virus is always present, why after tumors are once ed no additional cells of the host are converted malignant ones In the growth of metastases, from epithelial tumors, in the spleen, the lungs and other organs one can see plainly that they are com posed of descendants of cells from the original tumor they stand out in marked contrast to the surrounding tissues The same is true when tumors are trans planted from animal to animal One can back out of the situation by assuming that the virus is so intimately attached to or secured within the cells that it can not get away to neighboring cells while it can readily be transmitted to daughter cells where it multiplies for the next generation of cells Most tumors have many dying and dead cells offering a chance for the release of the virus but this does not seem to result in chang ing neighboring normal cells into malignant ones Having somewhat arbitrarily ruled out all the virus tumors from our class of malignant ones we will pro ceed to other tumor producing agents

One of the most if not the most prolific sources of induced animal sarcomas are the tapeworm cysts of the liver resulting from the feeding of tapeworm eggs of the cat to rats At the Institute of Cancer Research, New York over 4 300 such tumors have been produced in this way The larvae pass from the stomach to the liver and induce cyst formation about them In the walls of such cysts there frequently develop after many months typical sarcomata of one sort or another There has been considerable speculation in the minds of people who have had anything to do with tumors as to the causative factors involved Long continued irritation the favorite factor of the clinicians the pos sibility of a virus being carried along with the larvae and of chemical products of the latter have all been considered without arriving at a definite answer From none of these tumors has a filterable virus been ob tained that will reproduce the tumor A number of these tumors have been transplanted from animal to animal for considerable periods of time and we have had the privilege of studying several One of them has been carried for over 4 years in vitro They fall readily into the class of malignant tumors

The occurrence of certain occupational cancers led two Japanese workers to experiment with tar They succeeded in producing cancers on the ears of mice after repeated applications over a long period of time This has been many times repeated and led to testing out of purified products from tar During the past few years, some English workers have succeeded in producing both carcinoma and sarcoma in mice and rats with such products, namely, 1 2 5 6 dibenzan thracene and related substances

These chemically pure substances produce typical malignant tumors in a relatively short time, six months or less with the dibenzanthracene and in a considerably shorter time with methylcolanthrene The sarcomata were produced by injecting subcutaneously under

strictly aseptic precautions very small amounts of dibenzanthracene dissolved in lard. These experiments would seem to eliminate the direct participation of living agents of any sort as the cause of the tumors and also to eliminate the old idea that true tumors are produced by the uncontrolled multiplication of normal cells induced by the presence in, on or near the cells of a living agent. It is interesting to note that these recently discovered tumor producing substances are chemically related to the oestrous producing hormones. So now it is quite stylish to work on the hormonal origin of tumors. With the new group of tumors produced by chemically pure substances 1 2 5 6 dibenz anthracene there is a fine opportunity to test out the filtrates. My guess is that such tumors will not give filtrates with either virus or chemical agents which can reproduce the tumor especially after they have been transferred for a few times from animal to animal.

Having eliminated for the time being at least the idea that malignancy is due to living agents of any sort we must also eliminate the continued presence of some chemical agent that might be responsible for the peculiar properties of malignant cells such as (1) the uncontrolled growth in the body (2) the transplantability to other animals of the same strain or species (3) the peculiar cytological characters which serve to distinguish them from normal cells and (4) the maintenance in vivo and in vitro of these characteristics for generation after generation and year after year.

It is conceivable that the continued presence in, on or near normal cells of some special chemical agent might be responsible for the peculiar properties which are assigned to malignant cells. Let us suppose that four fibroblasts are converted into malignant cells at the site of injection of 4 mgm of dibenzanthracene, which is enough to induce a tumor. In a few weeks a tumor 40 mm in diameter will result with something like 4 billion cells. There will then be about one billionth of a milligram per cell to keep it in line. Suppose a number of metastases have developed in the body, since they consist of descendants of the original tumor cells, the allowance of dibenzanthracene per cell may then be not one billionth of a milligram but one two or one three billionth of a milligram. One may assume that that is enough of the agent to keep the malignant cells malignant. We are so accustomed to talking in billions these days that billionths may not seem so small.

It seems improbable, however, that such an agent could remain present in sufficient quantities to continue potent during the many cell divisions involved either in vivo or in vitro when cells are transplanted from animal to animal or culture to culture over a period of years, unless there was a continued addition to the original amount of the chemical agents which started the cells off in their new line at the time of the origin of the tumor. In the course of a month rat sarcomas often attain diameters of 40 mm or more. From such a tumor 100 rats could be inoculated. At the end of another month 10,000 could be inoculated. At the end of a year the astronomical number of 10^{24} rats would be running around each with 4 billion tumor cells. If the chemical agent were as simple as water there would be only about one half a molecule per cell. So we can dismiss the notion that the presence of some of the original chemical agent keeps the cells malignant or keeps otherwise normal cells in this condition.

It is possible that the chemical agent could be supplied by the host to keep the cells malignant during their multiplication in the original animal in which the original tumor arose. It is rather improbable that animal after animal for generation after generation could supply the agent to keep the transplanted tumor cells going and next to impossible for such a chemical agent to be introduced into a long series of in vitro cultures automatically with the medium where for example rat tumor cells are cultivated in horse serum, chick embryo juice chicken plasma and a saline solution.

There is another idea which we might dwell on for a moment namely that the original agent might stimulate the cells to produce more of that particular agent and thus maintain the malignant nature of the multiplying cells. This is visionary and would imply an alteration of the cell.

I have omitted the x ray cancers and the various spontaneous malignant tumors of man and animals. The very designation of the latter as spontaneous indicates that we know nothing definite about their origin. The x ray cancers presumably arise as a result of injury to the epithelial cells; the presence or supposed presence of a ubiquitous virus is difficult to rule out but the probabilities are that they too arise from altered cells.

These considerations thus seem to eliminate the idea that malignant cells are merely normal cells under the continuous stimulation of some extraneous agent. The most plausible alternative concept is the one we are considering, namely, that malignant cells are permanently altered cells derived from normal cells.

We have little definite information as to the steps in the alteration. There are as already noted a number of known agents which can change normal into malignant cells. The known agents take weeks or months to produce malignant cells or to produce tumors that are palpable. This may indicate long continued action and slow gradual change of one or a few cells or it may indicate that many cells are altered in various steps, and that only rarely is the alteration of such normal

acter as to produce a malignant cell. Dr. Mendelsohn, working in our laboratory, has found that fourteen day tapeworm cysts of the liver show all sorts of abnormal mitotic figures similar to those found in tumors, yet palpable tumors do not appear until 8 to 22 months later. What relation these early abnormal mitoses bear to the origin of tumors is uncertain, but it shows that the cells are already being upset long before tumors appear.

Having succeeded in getting the malignant cell started as an independent type of cell let us consider some of the differences between normal and malignant cells.

One of the outstanding differences between normal and malignant cells is controlled versus uncontrolled multiplication in the body. All normal cells are under control of some sort. The nature of the control mechanism is obscure but fundamental for all multicellular organisms. It begins at the 2 cell stage and continues throughout life. So familiar are we with the manifestation of this law that deviations from it at once attract attention. The control is elastic: it permits of increase and decrease of organs and parts through use and disuse, disease and recovery, injury and healing and regeneration. The end result is a return or an attempt to return the part to the normal condition. The swellings that develop in some infections from induced cell multiplication are sometimes remarkably like malignant tumors, but when the infectious agents are overcome the tissues tend to return to normal.

Malignant cells, on the contrary, continue to multiply like parasites, frequently spread through the body and continue to increase in number until they kill the host. This uncontrolled multiplication of the malignant cells sets them apart from all normal cells. All tumors have this important characteristic of uncontrolled growth in common. Some very malignant ones grow and spread like wild fire and kill in a short time, others grow slowly and benign tumors may last for years and years as though their cells were almost under control. All gradations between these extremes are found. We are concerned more especially with the cells of malignant tumors, rather than with those of benign ones.

Malignant cells tend to grow in a disorderly manner, especially the more malignant ones, and produce structures with little resemblance to normal organized tissues. Their metabolism is altered. The production of normal secretions is debatable. The usual assumption is that they produce harmful rather than useful metabolic products. The increase in malignant cells can not be attributed to a demand by the rest of the body for their secretions as with normal ones.

There are, as you know, quite a number of transplantable rat and mouse tumors that have been carried for years by serial inoculations of small pieces of the tumor from animal to animal of the same species. Several tumors have been thus maintained for many years, ten, fifteen, twenty and even thirty years. The essential part of the technique is that living malignant cells shall be inoculated into animals of the same species or strain. There are some tumors that take in nearly 100 per cent. in almost any strain, others take in smaller percentages and still others take in only the particular strain in which they originated. Of the many spontaneous and induced tumors of rats and mice only a small percentage has been found to be transplantable. This is partly because some have not been tested or have been given only a perfunctory trial and partly because it often makes a very great difference as to whether or not inoculations were made into animals of the same strain and on the purity of the strains. Many of the failures may be attributed to the fact that the tumors tested originated in such mixed strains that no two animals had anything like the same genetic constitution. Recently a series of tumors were produced in five inbred strains of mice and one "stock" mixed strain with 1, 2, 5, 6 dibenzanthracene by Andervont. Some mice of each strain developed tumors. There were about 100 per cent. "takes" when tumors were transplanted into animals of the same strain in which the tumor originated and 100 per cent. negative results when transplanted into the other strains. The subsequent serial transmission of these tumors to animals of the same strain were about 100 per cent. successful and 100 per cent. negative into animals of another strain. This illustrates the importance of dealing with pure inbred strains and may explain the negative results in the many attempts of serial transmission in mixed strains where no two animals have the same genetic constitution.

It is well known that in mammals most normal cells and tissues do not live long when transplanted to another animal of the same species. This curious individuality of each animal's tissues has received considerable attention from St. Louis' pathologist, Leo Loeb. The surgeons are well aware of this specificity from the universal failures with skin grafts from one individual to another. Attempts made to so cultivate skin epithelium that it will lose this individual specificity and thus be transplantable to any one have not been successful. The failures of ordinary normal tissue transplants from animal to animal and man to man are probably associated with differences in genetic constitution. No two animals of mixed colonies and certainly no two humans, except identical twins, have the same genetic constitution. When we turn for example to pure inbred strains of guinea pigs the success of cross transplantation of normal tissues increases with genetic identity as shown by Leo Loeb and his asso-

ciates Brother to brother transplantations in an in bred guinea pig strain were nearly equal to auto transplantations In inbred strains of rats, however, through brother and sister matings up to the forty seventh generation, there seemed to be no distinct diminution in the reaction against transplants within the inbred family as compared with non inbred ones

On the whole, however, malignant cells are much more readily transplantable from animal to animal than normal ones, especially among animals of mixed genetic strains This is unfortunate in view of the desirability of supplementing defective organs of one sort or another by the transplanting of normal organs or parts of normal organs into individuals with defec tive ones Efforts are being made to train normal cells into transplantable ones If they could be made slightly malignant or, perhaps better still, converted into benign ones in vitro the problem might be solved At present we are still much in the dark as to why malignant cells are transplantable and normal cells not

The behavior of malignant cells when cultivated over long periods of time in vitro is a strong argument for the idea that they are permanently altered cells The malignant cells of a mouse adenocarcinoma have been carried in pure cultures for seven or eight years by Fischer without losing their malignancy Carrel and Ebeling carried two rat sarcomas for 16 months with the same result We have at present pure cul tures of malignant cells from six different rat sarcomas that have been cultivated in vitro from one and a half to over 4 years They have retained their essential cultural and cytological characteristics and their malignancy during the cultivation

These sarcomas are all well established transplant able tumors that had been carried on in rats for gen eration after generation for 3 to 20 years Our studies on the behavior and cytology of the malignant cells from these tumors in simple hanging drop cultures began after the tumor had become well established in animals and were continued for some time before serial cultures were undertaken and were also carried on parallel with the serial cultures The many series of cultures in simple hanging drops of chicken plasma rat plasma and combinations of the two, with and without neutral red, enabled us to become quite familiar with the cultural and cytological character istics of the malignant cells Both the outgrowth pat terns and the cytological characters of the cells are different from those of normal cells and from one another

Attempts were made to cultivate a number of other transplantable rat and mouse tumors in serial cultures, only to have the cells die out on our hands after a few generations I attribute the failures to lack of suitable media and imagine that some day it will be possible to cultivate almost every type of malignant cell indefi nitely outside the body

The six tumors which we have carried on in serial cultures comprise three round cell sarcomas, one spindle cell sarcoma, one rhabdo myosarcoma and one polymorphous (mixed) cell sarcoma The small pieces of tumor tissue with which the serial cultures were started contained many macrophages, monocytes, lymphocytes, fibroblasts and endothelial cells in addi tion to the malignant cells Thus the primary cultures were mixed and sometimes contained all the above types of cells in the migratory zone After a varying number of transfers we found without any special effort that the colonies contained only malignant cells with the possible exception of those from the poly morphous cell sarcoma Various combinations of chicken plasma dog plasma human plasma, rat serum, human placental serum, horse serum beef embryo juice chick embryo juice and saline were used

The colonies were carried in two types of cultures, the large sitting drops by Mrs Gey and the roller tubes In the former the cell colonies were replanted every four days into fresh clots without a supernatant nutrient fluid The colonies in the roller test tubes were replanted at varying intervals of 4 to 21 days, depending upon the condition of the colonies The roller tube cultures have a thin clot of blood plasma lining the tube in which the colonies grow and a super natant nutritive fluid which was changed every 4 days From time to time simple hanging drop cultures were made from the large colonies for cytological examina tion Rats were also inoculated every few months with one to several colonies to determine the malignancy Up to the present the cells have maintained their essen tial cytological characters and malignancy Some are not in as good condition as those taken directly from tumors, while others seem to show no ill effects from their prolonged life in vitro

The inoculations into rats of the pure colonies of malignant cells have resulted in about the usual num ber of "takes' giving rise to typical tumors Cultures from these tumors displayed the typical array of malignant cells, macrophages monocytes, lymphocytes fibroblasts, etc The malignant cells were similar to those from tumors that have been carried on fro animal to animal during the same period sent period preceding the serial culture experime won malignant cells, not in good condition, freq r an duced typical tumors, and cultures from th and good healthy malignant cells, indicating iminary after inoculation into animals, and also y's bulle- not seriously injured or modified d," accom

In a few instances serial cultures f the trips, tumors produced by the inoculation ools, normal

These serial cultures gave in due course of time pure strains of malignant cells which in turn produced typical tumors. The tumors produced by the pure strains of cells are transplantable as were the progenitors of the tumors of the pure strains and some have been carried on from animal to animal for a number of generations.

The conclusive evidence that one has obtained the malignant cells is their recognition in cultures, their cultivation in pure strains, the production, on inoculation of the latter into animals of the same species or strain, of typical transplantable tumors and the recognition again of the malignant cells in cultures of such tumors. These conditions have been fulfilled with the above six rat sarcomas. The fact that the malignant cells have maintained, through all the vicissitudes of prolonged serial cultivation, their essential and recognizable cytological as well as their cultural characteristics which are peculiar for the malignant cells of each tumor and are different from normal cells speaks strongly for the idea that they are permanently altered cells that bred true.

Let us now turn to the most difficult task of all, namely, to give you in words an adequate idea of the cytological differences between normal and malignant cells and between the various malignant cells themselves. Our observations are based on the study in tissue cultures of the malignant cells of 27 rat and mouse tumors. Some have been studied again and again over a period of years, others in only a few or a single set of cultures.

Let us consider sarcoma cells with which I am most familiar. Supposedly they come from fibroblasts or other cells derived from the middle germ layer, and until we know better I shall compare some of the malignant sarcoma cells with fibroblasts. If I could lay before you a series of photographs which I have in Baltimore of living fibroblasts and of living sarcoma cells at a magnification of 1,000 diameters you would see at once that malignant cells are different from fibroblasts, and then you would begin to see that the sarcoma cells from each tumor were different from those of every other tumor. If I could put before you groups of photographs of a number of cells from each
f the tumors you would see that the cells in each group
ied considerably, yet those from any one tumor are
ture alike and enough different from those of any
sues. mor to be assigned to their own kind. Fibro-
ti normanld also show similar variations. The cells
cel s that ne tumor vary like the leaves on a tree, no
the etabolictly alike, yet a red oak leaf is a red oak
com s can naple leaf a maple leaf, in spite of con-
Al body fotion in size, shape, etc. You would also
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round cell sarcomas or the polymorphous and mixed cell sarcomas. It is probable that the malignant cells of spindle cell sarcomas come from fibroblasts. It is not so evident from what cells some of the other sarcomas arise.

The general architecture of malignant fibroblasts is similar to that of normal ones and is best seen in cells flattened out on the coverglass. The spread-out normal resting fibroblast has a very delicate transparent cytoplasm. It is often difficult to detect the edge in some places, rather easy in others. The more or less excentric oval nucleus is also clear and transparent; the small nucleoli are the only things to be seen in it. The nuclear membrane is extremely delicate. At the center of the cell is the centriole, not usually detectible in the living cell and rarely seen in photographs. About this center are a few granules and mitochondria, then a little further out are the fat globules and more mitochondria. Scattered granules, fat globules and mitochondria occur in the peripheral ectoplasm and cell processes. The mitochondrial threads tend to be radially arranged about the centriole. This is about the picture one gets of normal living fibroblasts that are spread out on the cover-glass in fresh cultures during the first 24 hours. The whole arrangement becomes emphasized in older cultures. The finely granular central area surrounding the centriole becomes greatly enlarged. About this is a zone of neutral red stainable granules and small vacuoles, about this in turn is usually a heavy zone of fat globules and about the periphery of the cell is the relatively clear ectoplasm. The mitochondria are not confined to any one zone but become more or less radially arranged in reference to the central area and centriole. The nucleus is pushed to one side against the fat globule zone by the enlarged central area.

Malignant sarcoma cells have the same general arrangement. The cells from some sarcomas even in the 24-hour cultures have large central areas, some have heavy fat zones, others very little fat, some have scarcely any neutral red granular zone, others have quite a good one, but it is rarely as prominent as in normal cells. In general the resting malignant fibroblasts as seen in cultures have less transparent and more granular cytoplasm, larger nuclei in proportion to cell size, heavier nuclear membranes and larger and more irregular nucleoli than normal fibroblasts. The arrangement of the fat globules is often a little different. The malignant cell accumulates as a rule fewer and smaller neutral red granules than normal cells. The mitochondria tend to be smaller and more numerous than in normal ones. The nuclei of malignant cells are much more frequently deeply indented on the central side than those of normal ones. This pocket may be quite extensive. A superficial examination of

such a nucleus might lead one to think that the nucleus was highly granular, as the nucleus forms a thick shell like a pushed-in rubber ball, around the pocket filled with granular cytoplasm of the central area. The nucleolar material is sometimes so extensive and broken up into granules that it gives the nucleus a granular appearance, but one can still see plenty of clear nucleoplasm.

Malignant cells are usually larger than normal ones but not always. Owing to the variations in the amount of spreading out on the coverglass about the only safe way to compare cells is to measure ones that have become spherical. The malignant cells of some tumors are fairly uniform in size, while those from others vary enormously, such variations being characteristic for the tumor. There is something very difficult to define but rather characteristic about the manner in which normal and malignant cells spread out on the coverglass that enables one to distinguish at a glance a normal from a malignant cell and the various malignant cells from one another. Malignant cells often have peculiar ruffle pseudopodia somewhat like those on macrophages but different from the wavy edge of normal fibroblasts. They are the organs for pinocytosis, a common habit of malignant fibroblasts. Pinocytosis is a fancy name for cell drinking, a habit normal fibroblasts rarely indulge in. The macrophages, as I pointed out long ago, are great drinkers. Phagocytosis is also more common with malignant fibroblasts than with normal ones. One could go on for some time relating how this and that type of malignant cell differs from a normal one, much to your confusion.

There is no one startling character which serves to distinguish malignant cells from normal ones, yet among those which I have studied in tissue cultures, and they comprise ones from 27 different tumors from the rats and mice, there is no great difficulty in recognizing most of them. The whole cell is more or less altered. It is a sort of a constitutional thing. There are all sorts and combinations of slight differences between normal and malignant cells and between the various types of the latter. Long familiarity, as with many other things in life, enables one to distinguish at a glance differences and qualities that a long and arduous description would fail to reveal.

There are, however, some malignant cells such as those from the spontaneous adenocarcinomas of the mouse that seem to have no visible malignant characteristics, according to Mrs. Lewis and Strong.

It will be noted that the term mutant has not been mentioned for these altered cells. A mutation, according to the geneticists, depends on some alteration in the genes or chromosomal complex. In common parlance mutant may be used for any sort of alteration that descends from generation to generation, but the general inference has been when speaking of malignant cells as mutants, to assume that their peculiarities are due to gene alterations. Up to the present there is no proof that chromosomal or gene alterations are responsible for the various malignant cells and it would be very difficult to prove that the genes were altered even if they were. The chromosomes are numerous and small, and it will be a long long time before one can see in them anything at all comparable to what the giant chromosomes of the salivary gland of the fruit-fly reveal.

Malignant cells are notoriously afflicted with chromosome troubles. The amazing variations in the chromosome picture of fixed and stained preparations in sections and cultures hold the eye to the exclusion of the rest of the cell, which does not show much of anything anyway in such preparations It is often worse than looking for the soft parts in a fossil

More mature consideration of such facts as we have at hand has convinced me, temporarily at least, that the chromosome abnormalities are only the manifestation of a more subtle trouble of the cell. A boil, a fever and leucocytosis are manifestations of an infection, not the cause of it. A short survey of the chromosomal abnormalities of malignant cells may convince you also that they are secondary phenomena to other changes in the cell rather than primary, even though one has not determined exactly the primary change.

Most if not all tumors show cells with abnormal chromosomal complexes and mitotic figures as well as normal ones. Some tumors display an astonishing array of abnormal mitotic figures that are repeated in a long line of serial transplanted tumors. There occur cells with the haploid, diploid, tetraploid and greater numbers of chromosomes. In addition cells are encountered with a few more or less than the above numbers. In these tumors all sorts of irregularities of cell division abound, such as division into three or even four equal or unequal cells with an equal or unequal number of chromosomes. Cells with such variable numbers of chromosomes frequently undergo mitoses and are encountered in cultures, especially those from the Walker spindle-cell sarcoma 338 made from time to time over a period of years. This leads one to suspect that the exact full complement of chromosomes or any exact multiple thereof is not essenti-l to the continued life of a malignant cell. One won
if after differentiation is completed the exact r
of chromosomes is essential for the continu
any somatic cell. In cultures of embryonic
one occasionally encounters normal cells
mal division figures such as tripolars w
mosomes have every chance of being u
uted to the three daughter cells. I ha

abnormal mitosis are sometimes encountered in inflammatory areas

The unequal distribution of chromosomes during tripolar divisions of malignant sarcoma cells comes about from the usual condition of unequal size of the three limbs of the Y shaped metaphase plate and also from the fact that total numbers of chromosomes in the three limbed metaphase plate is usually not sufficient to give each of the three daughter nuclei the normal number of chromosomes The interesting thing in connection with the variable number of chromosomes in such cells is that the tumor cells from any one tumor are all essentially alike in spite of the fact that some of them are small and have small nuclei and few chromosomes, that some are intermediate and have intermediate sized nuclei and that some are large, have large nuclei (giant nuclei) and more than the normal number of chromosomes Since otherwise the general cytological and cultural characteristics of such malignant cells of any one tumor are similar to one another and to those with the normal number of chromosomes it would follow that chromosomal variation has no particular effect on the cytoplasm except increasing or decreasing its volume

Malignant cells with two to several nuclei are frequently encountered in cultures from several of the tumors without noticeable change in the character of the cytoplasm The nuclei in such cells usually vary in size and often no two nuclei even in the same cell are of the same size From studies on the tripolar divisions with unequal distribution of chromosomes and cytoplasm to daughter cells we find that the nuclei resulting therefrom vary in size according to the number of chromosomes It seems probable, therefore, that multinucleated cells having two or more nuclei of unequal size have not two, three or four times the number of chromosomes but variable numbers something more or less than 2, 3 or 4 times the normal number yet the cytoplasmic characteristics remain unchanged The same thing applies to various sorts of normal cells with two or more nuclei

Abnormal distribution of chromosomes may also come about through the occurrence of lagging and aberrant chromosomes Not infrequently one or more chromosomes fail to get into the metaphase plate and when the two groups of chromosomes pass to the daughter nuclei they are not included, but are left in mı cytoplasm where they form small chromosomal that ıs A somewhat similar displacement of chromo abolict occurs when one or more chromosomes fail to can napl daughter nuclei from the metaphase plate fo ıon chromosomes are left behind, outside the are, ls thei where they also form small vesicles rat her fate of such chromosome vesicles and them is unknown, but the latter retain their essential cytological characteristics as long as they have been followed The cytological characteristics of malignant cells after they have become differentiated are thus apparently not dependent on the maintenance of the exact complement of chromosomes From this it seems probable that chromosome or gene alterations have nothing to do with the origin of malignancy The variable distribution of chromosomes in malignant cells is probably secondary to alterations of other parts of the cell, the cytoplasm and centrosomal system

That chromosome troubles are not primarily due to gene alteration is also borne out by the experiments in our laboratory on normal cells in cultures, of Mrs Lewis on the effects of fluorescent X of Rosenfeld on the effects of ether and ammonia and of Whitman on those of radium

Fluorescent X causes the terminal ends of some of the chromosomes to adhere so that they fail to completely separate at the usual time during anaphase This results in lagging chromosomes and unequal distribution to the daughter nuclei In some cells one or more lagging chromosomes were omitted from each daughter nucleus in others the two sister chromosomes passed into one daughter nucleus In strong concentrations of the dye the chromosomes failed to separate into two groups Cytoplasmic division ensued, however, and the chromosome complex was mechanically squeezed into two masses to form the nuclei for two daughter cells with an unequal distribution of chromosomes

Rosenfeld found that when normal cells in metaphase or anaphase were subjected to ammonia the progress of mitosis was interrupted Sometimes the chromosomes became aggregated into a single nucleus with the tetraploid number and on the return to the normal culture medium formed a large resting nucleus normal in appearance in a large cell in which the cytoplasmic division was suppressed Sometimes after the initial aggregation the chromosomes became scattered in the spindle area and after the return to the normal medium, when cleavage occurred the daughter cells contained unequal numbers of chromosomes He also found that ether produced abnormal mitoses, following an initial aggregation of the chromosomes On return to normal medium a variety of events occurred Sometimes cleavage was suppressed, as with ammonia, and a large nucleus with the tetraploid number of chromosomes or a binucleated cell resulted Radium also produces abnormal mitoses, lagging and aberrant chromosomes and unequal distribution to the daughter cells, yet radium has never been known to produce tumors in man in spite of extensive use

I do not care to push too hard at the idea that malignancy is due primarily to cytoplasmic alteration

rather than chromosomal or gene ones, but I am inclined to consider it from that angle at present. The important point which I wish to emphasize is that malignant cells are permanently altered cells that breed true. They are new types or species of cells. This undoubtedly holds for the malignant cells of spontaneous as well as induced tumors. Many spontaneous tumors seem to arise *de novo* as the result of unknown factors at play within the organism entirely unconnected with any outside environmental effects. Others seem to arise from a combination of environmental and autofactors as in locations of chronic irritations. I often wonder if irritable people are more subject to brain tumors than placid ones. If autofactors can produce malignant cells perhaps they can also produce useful alterations. Who knows but that something of this sort has played an important rôle in our evolution and even in our development from the egg. Genes seem to hold the stage just now, but it is not at all clear just how they induce development or evolution. The field is still open to speculation, one of the great sports of mankind.

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

The annual report of the National Physical Laboratory, which appeared recently, according to a summary in the London *Times*, states that during 1934, the year under review, there was an increased demand for industrial investigations which was most marked in the work called for by the shipbuilding industry. The much greater attention given throughout the country to the subject of noise was also reflected in the work of the laboratory and there was an increase in the number of investigations.

At the William Froude Laboratory no fewer than 60 different designs of ships were tested, this being the highest number since the laboratory was opened in 1911. The modifications in design suggested and carried out by the laboratory have effected large improvement in connection with the resistance of a number of the vessels and it is estimated that, assuming only one ship of each type was built, that each was steaming for only 200 days a year and that the life of the ships was 20 years, the net saving to the industry in coal bills alone would be £500,000. Observations made of the height of waves in the Atlantic showed that in a storm they might be up to 25 feet high, rising to 40 feet in a hurricane and that the distance from crest to crest might be about 275 feet.

The subject of noise abatement received much attention in the new acoustics laboratory, and assistance was given to the Ministry of Health in connection with the sound proof properties of modern walls for use in flats, to the Building Research Board on sound transmission through floors, and to the Ministry of Transport on the limitation of noise from mechanically propelled vehicles.

A new wind tunnel has been designed, and is now in operation, which can be used for studying the behavior of miniature aerofoils, a few inches in length, at a wind speed of 650 miles an hour.

The old British radium standard, which was prepared by the late Mme. Curie in 1913, has been replaced by a new standard consisting of a sample of radium chloride of higher purity. The British radium standard is used for determining by comparison the quantities of radium in the needles and other containers used by hospitals.

A section of the report dealing with road research states that special apparatus has been constructed at the laboratory for continuous measurement of impact forces while a vehicle is running along a road. Extensive tests are also being carried out with a heavy six wheeled lorry running over rough and smooth roads near London, and over obstacles placed on the roads and on a private road near Oxford impact forces at speeds up to 40 miles an hour are being observed. The results so far obtained show that the maximum impact causing damage to road and vehicle does not necessarily occur at the highest speeds.

Tests made with the object of enabling an aeroplane to fly stalled have led to the trial of a new biplane arrangement in which the upper wings are very much tapered while the lower wings slope considerably so that their tips come close behind the narrow tips of the upper wing. This arrangement was found to be as good as that of a normal biplane as regards performance and to have a much higher degree of steadiness in stalled flight.

The report, a quarto volume of 260 pages, with 59 illustrations, is obtainable from H. M. Stationery Office for 13s. net.

EDUCATIONAL GEOLOGIC TRIPS IN PENNSYLVANIA

The Pennsylvania Topographic and Geologic Survey in cooperation with the Pennsylvania Department of Public Instruction has recently inaugurated a plan for conducting geologic field trips for teachers and other interested Pennsylvanians. As a preliminary to the trips, some 2,000 copies of the Survey's bulletin 113, "Pennsylvania Geology Summarized," accompanied by a preliminary announcement of the trips, were distributed in March to high schools, normal

schools, colleges and universities throughout the Commonwealth This pamphlet summarizes the basic principles of geology and presents a condensed resumé of the geology of Pennsylvania Following its distribution, return reply cards were mailed to persons likely to be interested in field trips in two selected regions It was thought advisable to begin with a limited number of trips until it was determined how the scheme would be received Three excursions were subsequently held On May 4, two trips were conducted, the first in the morning and the second in the afternoon, in the region of Chambersburg These were in charge of R W Stone and Dr Bradford Willard, of the Geologic Survey and Walter F Hess of the Department of Public Instruction Mr Hess handled practically all the distributing of the literature and notifying the science teachers in high and normal schools On May 11 a single trip was conducted by Dr Willard at Stroudsburg Mr Hess again represented the Department of Public Instruction

Elements of physiography structural geology, paleontology, stratigraphy, mineralogy and economic geology were discussed on the trips with actual illustrations in the field An average of 40 attended each of the three trips The relatively small number made for easier handling of the parties and greater individual attention to questions On the whole the trips were considered satisfactory both by the persons attending them and those who were instrumental in their planning and execution Because of their success it is hoped to conduct similar trips in different parts of Pennsylvania in the future

BRADFORD WILLARD

GRANTS FOR RESEARCH OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT its meeting on April 10 the American Academy of Arts and Sciences announced grants in aid from the Permanent Science Fund as follows

To Frank M Carpenter, Museum of Comparative Zoology, Cambridge, $350, for expenses in connection with a collecting expedition to Kansas for the purpose of adding material necessary for his work on a 'Revision of the Lower Permian Insects of Kansas''

To Tenney L Davis, Massachusetts Institute of Technology $300, for technical assistance in the preparation and analysis of certain compounds essential to the completion of his study of the reaction of phosphorus trichloride with cuprous chloride

To Fred W Emerson, New Mexico Normal University, Las Vegas, $100 for aid in defraying expenses in connection with a study of the plant associations in the White Sands area near Alamogordo, New Mexico, and in collecting material for the study of palisade cells in desert plants

To Walter S Hunter, Clark University, $150, for apparatus, assistance and other expenses to be incurred in investigating the inhibition and disinhibition of conditioned reflexes in human subjects

To J W McBain Stanford University, $250, for material and equipment to be used in a study of adsorption in the air water interface of various solutions

To Arthur S Graves Brooklyn Botanic Garden, $250, to help meet expenses in an investigation designed to produce a chestnut resistant to *Endothia parasitica*

To Professor Robert Weill of the Faculty of Sciences of the University of Paris $300 for aid in defraying expenses of a visit to the Bermuda Biological Station to study the nematocysts of Coelenterates

Applications for grants in aid from the Permanent Science Fund of the American Academy of Arts and Sciences will be received by the committee until September 15, 1935, for action at the October meeting of the academy Applications should be made to Professor E M East, *Chairman* Permanent Science Fund Committee, Bussey Institution, Forest Hills, Boston, Mass

AWARDS OF LATIN AMERICAN FELLOWSHIPS

THE award of six fellowships of the John Simon Guggenheim Memorial Foundation to Latin American scholars who will come to the United States has been announced

These fellowships are granted on terms generally similar to those governing the John Simon Guggenheim Memorial fellowships awarded to citizens of the United States They are awarded to men and women, married or unmarried, without distinction of race, color or creed The stipends both for Latin America and for the United States are usually $2,000 a year

At the present time Latin American fellowships are available to citizens of Argentina Chile, Cuba and Mexico and also to Porto Ricans The selection of the fellows whose names are now announced was made by a committee which met in New York, with the advice and assistance of leading scholars and advisory committees in the countries concerned Two hundred applications were presented this year

The awards now announced to assist the investigations specified are as follows

PROFESSOR ALFREDO BAÑOS, JR, professor of theoretical physics, National University of Mexico Studies of the physical nature of dielectric constant and of the conductivity of dielectrics, at the Massachusetts Institute of Technology

DR PEDRO J BERMÚDEZ HERNÁNDEZ assistant in zoology and paleontology, University of Havana, Havana, Cuba Studies of Foraminifera, especially from the paleontological point of view, with the purpose of contributing to a correlation of the Eocene faunas of Cuba

with those of the Gulf Coast of the North American mainland, chiefly at the Cushman Laboratory for Foraminiferal Research at Sharon, Massachusetts

DR. LUIS HOWELL RIVERO, assistant in anthropology University of Havana, Havana, Cuba Continuation of taxonomical and biological studies of West Indian fishes, chiefly at the Museum of Comparative Zoology, Harvard University The fellowship now awarded to Dr Rivero is a renewal of a fellowship granted a year ago

DR. ATILIO MACCHIAVELLO VARAS, chief of the Sanitary Inspection Service of the Northern Sanitary Zone of Chile, Antofagasta, Chile Continuation of studies in the fields of preventive medicine and public health, with especial reference to typhus, at Harvard University The grant now made to Dr Varas will enable him to spend a second year at work on problems of typhus in Chile, in collaboration with Professor Hans Zinsser, of the Harvard Medical School

DR. TEÓFILO ORTIZ Y RAMÍREZ, professor of clinical medicine, Faculty of Medicine, National University of Mexico, Mexico, D F Clinical studies in the field of cardiac physiology, at Harvard University

DR ENRIQUE SAVINO, bacteriologist in the Bacteriological Institute of the National Department of Hygiene, Buenos Aires, Argentina Studies in the field of public health, with emphasis on epidemiology, chiefly at Harvard University

The Committee of Selection which met in New York consisted of President Frank Aydelotte, Swarthmore College, *chairman*, Dr Thomas Barbour, professor of zoology and director of the Museum of Comparative Zoology, Harvard University, Dr Elmer Drew Merrill, director of the New York Botanical Garden Dr Antonio G Solalinde, professor of Spanish in the University of Wisconsin and Dr Richard P Strong professor of tropical medicine in the Harvard University Medical School

SCIENTIFIC NOTES AND NEWS

AMONG the honors awarded on the occasion of the seventieth birthday of King George and the twenty fifth year of his reign, the Order of Merit was conferred on Sir Frederick Gowland Hopkins, Sir William Dunn professor of biochemistry at the University of Cambridge and president of the Royal Society

THE trustees of the Humane Society of the Commonwealth of Massachusetts have awarded the gold medal of the society to Dr George R Minot and Dr William Parry Murphy, in recognition of their successful discoveries in the treatment of pernicious anemia The medals were presented by Charles P Curtis, president of the society, at the Peter Bent Brigham Hospital on May 23 The awarding of the medal to Drs Minot and Murphy marks a change in the policy of the society, which for a hundred and fifty years has awarded the medal for heroic rescues, where the life of the rescuer was at stake

MEMORIAL tablets to Samuel F B Morse and to Professor John W Draper were unveiled at the Washington Square Center of New York University on May 28 The tablets were erected by the State Education Department and the Greenwich Village Historical Society to mark the site of the original New York University building, where Morse sent the first message by electric telegraph and Draper made the first photographic portrait of a living person The tablets were presented by Catherine Parker Clivette, founder and president of the Greenwich Village Historical Society Granddaughters of the two inventors, Clara Morse and Dorothy Draper Nye, unveiled the plaques Chancellor Harry Woodburn Chase made the dedicatory address

THE honorary degree of doctor of engineering was conferred on May 30 by the South Dakota School of Mines on Dr Lyman J Briggs, director of the National Bureau of Standards, who gave the commencement address Degrees were also conferred on the Honorable George H Dern, Secretary of War, Dr Gilbert H Grosvenor, president of the National Geographic Society, Dr John Oliver La Gorce, vice president of the National Geographic Society, and Captain Albert W Stevens U S Army, leader and scientific observer of the stratosphere flight The ascent from Rapid City, S D, of the stratosphere balloon under the auspices of the National Geographic Society and the U S Army corps is planned to take place as soon as weather conditions are favorable

HONORARY degrees were conferred by McGill University on May 30 on Dr A S Eve, retiring professor of physics at the university, on Dr O T Avery, of the Rockefeller Institute for Medical Research, on Adelard Godbout, Quebec Minister of Agriculture, and on Abbé Georges Lemaître, professor of astrophysics at the University of Louvain

AT the seventy second annual commencement of Kansas State College on May 27 the honorary degree of doctor of science was conferred on James T Jardine, chief of the Office of Experiment Stations, U S Department of Agriculture The honorary degree of doctor of engineering was conferred on George W Wildin, of the class of 1892, consulting engineer, of Pittsburgh, Pa, and on Ernest H Freeman, of the class of 1895 professor of electrical engineering at the Armour Institute of Technology

OGLETHORPE UNIVERSITY, Atlanta, Ga, at its com

mencement exercises held on May 26, conferred the degree of doctor of science on Dr. Annie Jump Cannon, assistant astronomer and curator of astronomical photographs at the Harvard College Observatory, and on Dr. Florence Rena Sabin, member of the Rockefeller Institute for Medical Research.

THE honorary degree of doctor of laws was conferred on Arthur Gibson, Dominion entomologist, by Queen's University, Kingston, Ontario, at the spring convocation.

THE presentation of the Herty Medal for this year was made on May 18 at the Georgia State College for Women to Dr. Francis Perry Dunnington, of Charlottesville, Va., at a dinner given by the Georgia Section of the American Chemical Society. Dr. Dunnington has served as professor of chemistry at the University of Virginia for forty eight years.

THE Lucien Howe Medal in ophthalmology of the University of Buffalo has been awarded to Dr. Joseph H. Globus, associate neurologist at Mount Sinai Hospital, New York City, and to his associate, Dr. Sidney Silverstone, a member of the house staff, for their work on the diagnostic value of visual defects in brain tumors.

ARTHUR H. YOUNG, vice president in charge of industrial relations of the United States Steel Corporation, received the Henry Laurence Gantt Medal for his work in industrial relations at a dinner in New York City, on May 24, of the Institute of Management of the American Management Association. Professor Sumner H. Slichter, of Harvard University, was the principal speaker.

THE Lister Medal for 1936, which is awarded in recognition of distinguished contributions to surgical science, has been granted to Sir Robert Muir, professor of pathology in the University of Glasgow, who will deliver the Lister Memorial Lecture in 1936 at the Royal College of Surgeons of England. This is the fifth occasion of the award, which is made by a committee representative of the Royal Society, the Royal College of Surgeons of England, the Royal College of Surgeons in Ireland, the University of Edinburgh and the University of Glasgow. It is now seventy five years since Lister became professor of surgery in the University of Glasgow.

AT the annual meeting of the Medical Society of London, on May 13, the president, Lord Horder, presented the Fothergillian Gold Medal, awarded by the society every three years, to Sir George Newman, who retired in March from the posts of chief officer of the British Ministry of Health and of the Board of Education.

AT a recent meeting of the Paris Academy of Medicine, Professor Crouzon, of Paris, was elected a fellow, and Professor Johannsen, of Sweden, and Lord Moynihan, of England, were elected non resident fellows.

AT the recent meeting of the Royal Society of Canada at Hamilton, Ontario, Dr. R. W. Brock, dean of the faculty of applied science at the University of British Columbia, formerly director of the Canadian Geological Survey, was elected *president*; L. J. Burpee, *vice president* and *honorary secretary*; G. A. Young, *honorary treasurer* and *librarian*, and John Patterson, *honorary editor*.

DR. G. J. HUCKER, chief in research in bacteriology at the New York State Agricultural Experiment Station at Geneva, was elected chairman of the Central New York Branch of the Society of American Bacteriologists at the annual meeting held in Ithaca on May 25.

DR. MERRITT L. FERNALD, for twenty years Fisher professor of natural history at Harvard University, has been appointed curator of the Gray Herbarium. He succeeds Dr. Benjamin Lincoln Robinson, who retires at the close of the present academic year after having served for forty three years as curator of the herbarium.

HERBERT E. IVES, of Montclair, N. J., for many years in charge of research in television and color photography at the Bell Telephone Laboratories in New York City, has been appointed honorary fellow for research in color science at the Fogg Art Museum of Harvard University.

DR. JOHN L. BRAY, professor of metallurgy at Purdue University for the last twelve years, has been placed at the head of the School of Chemical Engineering to succeed the late Professor H. C. Peffer.

DR. RUTH MARSHALL will retire in June from the faculty of Rockford College, where she has served as professor of zoology for twenty years. She will be succeeded by Dr. Dorothy Richardson, of Mt. Holyoke College. Miss Marshall plans to continue her work on the taxonomy of the water mites.

AT the London Hospital Professor William Bulloch has resigned from the Goldsmiths' Company's chair of bacteriology and has been succeeded by Dr. S. P. Bedson. A new chair of chemical pathology has also been instituted, to which Dr. J. R. Marrack has been appointed.

DR. H. N. GREEN, at present lecturer in pathology in the University of Cambridge, has been invited to succeed Professor Florey in the chair of pathology at the University of Manchester.

DR. ROBERT M PETRIE, of the department of astronomy of the University of Michigan, has resigned to accept the position of astronomer at the Dominion Astrophysical Observatory at Victoria, British Columbia

DR. A C SEWARD, master of Downing College, professor of botany, has been appointed to represent the University of Cambridge at the sixth International Botanical Congress, to be held at Amsterdam from September 2 to 7, and Dr G H F Nuttall, Magdalene College, emeritus professor of biology, will represent the university at the tercentenary of the French Academy from June 17 to 20

AMONG the delegates from Great Britain present at the centenary celebration of the Royal Observatory of Brussels on May 14 were Professor F J M Stratton, director of the Solar Physics Observatory, Cambridge L J Comrie, superintendent of the British Nautical Almanac Office, Royal Naval College, and J H Reynolds, of the Royal Astronomical Society, London

DEAN CHARLES H LAWALL, of the Philadelphia College of Pharmacy and Science, will sail on July 3 for Copenhagen to attend a meeting of the Committee upon Uniform Method of Opium Assay, which has been working under the auspices of the Health Committee of the League of Nations since 1931 The chairman of the committee is Dr L Van Itallie, of the University of Leiden Other members are Dr Yasuhiko Asahina, of Tokio, Dr H T Baggesgaard Rasmussen, of Copenhagen, Professor R Eder, of Zurich, Dr A Goris, of Paris, Dr A W K De Jong, of Medan, Netherlands, Professor Erich Knaffl Lenz, of Vienna, and J R Nicholls, of London Dr LaWall is representing the U S Treasury Department as a pharmaceutical chemist assigned to this special research

THE Committee on Scientific Research of the American Medical Association has made grants to Dr Richard L Crouch, assistant professor of anatomy at the University of Missouri, to promote studies on the connections of the diencephalon in the monkey, and to the American Institute for the Deaf Blind to be used in aid of research relating to the vibratory sense This work will be carried on under the direction of Dr Robert H Gault, professor of psychology, and Dr A C Ivy, professor of physiology in Northwestern University

DR. RALPH SAMS HAWKINS, head of the department of agronomy of the College of Agriculture of the University of Arizona, delivered on May 22 the address of the retiring president of the Arizona Chapter of the Society of Sigma Xi, on "Research as an Aid in Regaining Arizona's Domestic Cotton Market"

DR LOTHAR W NORDHEIM, visiting professor of theoretical physics at Purdue University, gave a lecture at the University of Oklahoma on May 20 on "The Nature of the Metallic State" He also spoke before the department of physics on "Electron Free Path Phenomena in Metals"

A SIGMA XI lecture before the Brown University Chapter was given by Dr Edgar Allen, of the department of anatomy, Yale University School of Medicine, on "Recent Advances in the Study of Reproduction"

THE Halley lecture of the University of Oxford was delivered on June 5 by Dr J S Plaskett, director of the Dominion Astrophysical Observatory, Victoria, B C, Canada He spoke on "Dimensions and Structure of the Galaxy"

THE American Society of Zoologists will hold its thirty third annual session at Princeton University on December 30 and 31, 1935, and January 1, 1936 The headquarters will be at the Biological Laboratories in Guyot Hall, and arrangements will be made for accommodations at the Graduate College and the hotels in Princeton Detailed announcement will be sent to the members later

THE American Association of Cereal Chemists opened its twenty first annual meeting at Denver, Colo, for five days, on June 4

THE conference of Pennsylvania geologists, which convened in Philadelphia on May 31, devoted three days to the study of the crystalline rocks of southeastern Pennsylvania in order to secure additional information as to their origin, age and relations Some 200 geologists attended the conference The field trips were under the leadership of Dr Edward H Watson, of Bryn Mawr College, and Dr Benjamin L Miller, of Lehigh University Among those who were expected to take part were Dr George Ashley state geologist of Pennsylvania, Dr F Bascom, U S Geological Survey, Dr Arthur Bevan, state geologist of Virginia, Dr Marland Billings, Harvard University, Dr F Ward, Lafayette College, Dr Emmett R Dunn, Haverford College, Dr Charles Fettke, Carnegie Institute, Pittsburgh Dr Marcus I Goldman, U S Geological Survey, Dr Hugh D Miser, U S Geological Survey, Dr Edward Sampson Princeton University, Dr P Tolmachoff, Carnegie Museum, Pittsburgh, and Dr Herbert P Woodward, Dana College, Newark, N J

The Museum News reports that the Buffalo Museum of Science opened on April 4 the Cabana Hall of Man, a gift of Oliver Cabana, Jr The opening ceremonies included addresses by Kendall Emerson, executive secretary of the American Public Health Association, and Henry Vaughan, health commissioner of Detroit The Hall of Man is on the main floor of the museum between the halls of primitive races and of heredity and environment It is an exposition of the structure and

functioning of the human body Exhibits included are a life-sized radiograph of a living person, body cross sections in model, a moving skeleton actuated by an electric motor, flanked by a disarticulate skeleton, models showing chest and diaphragmatic breathing, a rubber lung, voice production and reflex action ex hibits, and exhibits showing the circulation of the blood all the heart valves and circulation mechanism being demonstrated in action

THE Department of Geology and Geography at Smith College has announced its plans for the summer program of work in the Black Hills The study of the Mississippian Pennsylvanian contact will be continued, and an effort will be made to determine the geographic range of the five faunal zones which have been differ entiated in the Upper Cambrian as a result of field and laboratory studies carried on during the past three years The western flank of the Black Hills will receive especial attention, and the group's activities, di rected by Howard A Meyerhoff and Robert F Col lins, will extend to the Bear Lodge Mountains, north of Sundance, Wyoming

THE use of 10,000 acres of cut-over timber land in Livingston parish for use as a laboratory in reforesta tion work has been extended to the department of forestry at Louisiana State University by the Great Southern Lumber Company, of Bogalusa The same organization cooperated with the department of for estry of the university in establishing a summer forest camp for students at Bogalusa About 16,000 trees have already been planted in the area by the farm forestry class, under the direction of Ralph W Hayes, head of the department

E G REX, New Jersey state supervisor of plant pest control, has announced that the Federal Govern ment is establishing a research unit at Morristown, to fight the Dutch elm disease New Jersey has already spent $65,000 on the program and the U S Department of Agriculture $720,000

COOPERATING with the Minnesota Department of Conservation, the U S Biological Survey has recently established the Talcot Lake Migratory Waterfowl Refuge, in Cottonwood County, Minn , and with funds from the sale of migratory waterfowl hunting stamps the bureau is restoring the area to its former useful ness for wildlife This project is the first to be financed by the duck stamp revenues Sponsored by E V Willard, conservation commissioner of Minnesota the Talcot Lake refuge is regarded by the Biological Sur vey as an example of the results obtained when conservationists work together Destroyed by drought, the lake is now being reflooded to provide habitat for waterfowl and fishing for sportsmen This dual pur pose is being accomplished through an agreement whereby the State Department of Conservation will acquire the lands and flowage rights and the Biological Survey will construct a dam in the nearby Des Moines River to restore the lake and to control water levels Approximately half of the 2,035 acre refuge is being conveyed to the United States for the Biological Sur vey's use as waterfowl breeding and feeding grounds, including a dry savannah that will be restored to its former marsh condition The remainder, including most of the lake proper, will be administered by the state for the benefit of fishermen and fur trappers, and in accordance with bureau recommendations regulated fishing and trapping will be allowed throughout the area to such an extent as will not interfere with the primary use of the refuge for water fowl conservation purposes. The state will assist in patrolling and otherwise protecting the refuge, and the bureau will undertake the biological development of the area and will introduce aquatic plants for waterfowl food and cover

The British Medical Journal reports that at a luncheon on April 20, held to celebrate the diamond jubilee of the Edinburgh University Chemical Society, Professor James Kendall, of the chair of chem istry at Edinburgh, said that the original foundation of this society went back, not to 1875, but to 1785, so that it was the first chemical society in the world Ex amination of the register of students at the university in 1785 had established that out of fifty nine members of the Chemical Society, fifty three were students attending Professor Joseph Black's class in chemistry How long the society survived after 1785 they did not at present know, but they hoped it might be possible to locate a descendant of one of the original members who was in possession of some record of its proceed ings and history It was possible that the Chemical Society of Philadelphia, which claimed to be the first chemical society in the world, might be an offspring of the original Edinburgh Chemical Society, because the University of Pennsylvania had been instituted in 1765, under strong Edinburgh auspices, and the coat of arms of Edinburgh University was still to be seen above the entrance to one of its original buildings

THE royal research ship *William Scoresby* arrived in London on May 14, after seven months' work in Antarctic waters This was the fourth visit to the Southern Seas, and was occupied entirely in observing and marking whales, this being the purpose for which she was designed and constructed It is hoped that this work will cast light on the migrations of the whales of the Antarctic whaling grounds. After final provisioning at Simonstown, South Africa, the *William Scoresby* sailed for the pelagic whaling grounds, and on December 1 the first whale was marked Soon afterwards the ship met pack ice, and from this time until her return whales in varying numbers were con-

stantly met, sometimes in small numbers, sometimes as many as 200 in one day The grounds visited were those about Bouvet Island, thence southward towards the ice and along the ice edge eastward to 90 deg, that is, to a position off Queen Mary Land in the Australian Antarctic Territory, then westward to the vicinity of Enderby Land Between her departure from Capetown and her return to that port at the conclusion of the marking, the *William Scoresby* steamed 17,500 miles and passed 122 days out of sight of land G W Rayner, a member of the *Discovery* scientific staff, was in charge of the operations, with Captain C R V Boothby, R N R, in executive command

THE London correspondent of the *Journal* of the American Medical Association writes "Again the figures of the registrar general show that as a people the English are growing older as a result of the falling birth and death rates. The birth rate for 1934 was 14 8 per thousand of population In the last thirty odd years the rate has been halved This fall is without parallel in the history of this or any other country The infant death rate in 1934 was 59 per thousand live births, in the quinquennium 1901–1905 it was 138 The general death rate has also been falling steadily In the quinquennium 1901–1905 it was 16 1 per thousand of population, in 1934 it was 11 8, which was 0 4 above that for 1933, the lowest on record The increasing aging of the population is shown by the proportion of the persons over the age of 70 years per 10,000 of the total In 1911 they numbered 297, in 1921, 344, in 1931, 426 and in 1932, 434 The registrar general therefore describes the increase in the number of old people as 'an outstanding feature of our vital statistics'"

DISCUSSION

THE NEW ACTIVE PRINCIPLE OF ERGOT

RECENT work, revealing the presence in ergot of a water soluble principle acting very promptly on administration by the mouth, has evidently aroused wide interest In the issue of SCIENCE for March 29 (*Supplement*, p 10) a short review was given of the paper[1] published on March 16, in which we described the isolation in crystalline form of the chemical characters and the action of the substance responsible for this effect—a hitherto unknown alkaloid, to which we gave the name "Ergometrine" This had resulted from joint work, on which we had been engaged ever since one of us (Moir) first demonstrated, in 1932 that watery extracts of ergot contained a substance different from any of the principles hitherto known and acting in this way[2] Though our work had thus extended over nearly three years, it had been interrupted by the circumstance that Moir accepted, during its progress, a pleasant invitation to visit the United States, where, during a visit of some six months, he had the opportunity of lecturing to American colleagues and demonstrating the method of recording contractions of the puerperal human uterus, which had first revealed the presence of this ergot principle, and which enabled it to be detected and measured in the course of our chemical work It is now evident that the matter was of such interest to colleagues in Baltimore and Chicago, where the lectures were given, as to stimulate investigators in both centers to independent researches, having the object of identifying the unknown principle Our own quest for it was resumed on Moir's return to London This concurrent effort has had the result, in many ways satisfactory, that our recognition of the principle as a new ergot alkaloid has received double confirmation, not only independent but almost simultaneous, from both these centers The March issue of the *Journal* of the American Pharmaceutical Association (p 185) contains a paper by M R Thompson, of Baltimore, who was probably the first to recognize that the unknown principle had alkaloidal properties His paper is chiefly concerned with an alkaloidal fraction containing it, and, from the details of the physiological action described it would appear that this fraction, which he calls alkaloid X, still contained much alkaloid of the ergotoxine type In a footnote, however, Thompson reports a later success in crystallizing what was very probably our Ergometrine The issue of SCIENCE for April 19 (p 388) publishes a statement entitled "Ergotocin," by M S Kharasch and R R Legault of Chicago These authors had apparently not yet seen our paper of March 16, or the abstract of it given by SCIENCE of March 29 In their own earlier paper on the subject, by Davis, Adair, Rogers, Kharasch and Legault, published in the *American Journal of Obstetrics and Gynecology* for February (p 155), the Chicago group described an impure preparation, having a high activity of the type under discussion, and regarded by them as non alkaloidal, and they there stated that Eli Lilly and Company had made arrangements to prepare and issue this preparation, and had "given it the trade name 'Ergotocin'" Again in a footnote, these authors recorded a subsequent success in crystallizing the principle, and it seems clear from the note in SCIENCE (April 19) that they have now recognized that the crystalline principle is alkaloidal and desire to transfer to it the name "Ergotocin" The characters which they attribute to it are those of Ergometrine

We should like to make it clear that it is far from our intention to engage in a discussion of priority on

[1] *British Medical Journal*, i, 520, 1935
[2] *British Medical Journal*, i, 1119, 1932

the basis of note book records There can be no doubt that these two American investigations were in progress simultaneously with our own, that they led to the isolation of the same substance independently and that the fact of its crystallization was, in each case, briefly announced at a date not distant from that on which we first described its properties and named it Our concern is to ensure that the further literature in an important field should not be complicated and confused by a multiplicity of names for the same substance Our paper, in which the name "Frgometrine" was given to the pure alkaloid, had in fact, already been published before that by Davis *et al* came into our hands, but, even if we had seen this paper earlier, we could hardly have felt entitled to consider the scientific adoption, for our alkaloid, of the name Ergotocin, which was there mentioned only as the trade name of an impure and supposedly non alkaloidal preparation We hope that, in suggesting to our American colleagues the propriety of adopting "Ergometrine' as the proper, scientific name for the pure alkaloid, we shall not be misunderstood as depreciating the contributions of those who have been working in the same field

H W DUDLEY

THE NATIONAL INSTITUTE FOR MEDICAL RESEARCH, LONDON

J CHASSAR MOIR

THE BRITISH POST GRADUATE MEDICAL CENTRE LONDON

THE PROTECTION OF WHALES FROM THE DANGER OF CAISSON DISEASE

THE interesting account by Laurie[1] of respiration in the large and active whales of the Antarctic has stimulated discussion of the problems presented by the necessarily peculiar respiratory activity of these animals during prolonged submersion at great depths As to the limits of their dives there may be some question, but there is no doubt that whales descend to the depth of 100 meters and thereby encounter hydrostatic pressure of about 10 atmospheres A terrestrial mammal which has been breathing air in a caisson at a pressure greater than 2 4 atmospheres encounters the danger of effervescence of the dissolved nitrogen in the tissues if by ascending rapidly the pressure is reduced more quickly than the blood can transport the released nitrogen to the lungs The resulting bubbles of gas obstruct circulation and cause caisson disease Whales do not apparently suffer from caisson disease, and yet their respiratory system is, as far as we can see, typical for mammals

The whale does not, however, enter a caisson and rebreathe air under pressure It submerges with one lung volume of air An estimate of lung volume at 10 per cent of the body volume can not be far wrong and would start the diving whale with about 8 per cent of its body volume as nitrogen Human divers do not suffer from caisson disease until they have been exposed to 2 4 atmospheres absolute pressure,[2] so that the human body can evidently rapidly eliminate the amount of nitrogen contained after saturation at the 1 4 atmospheres extra pressure In 100 cc of blood and other tissues about 1 cc of nitrogen is dissolved per atmosphere of pressure, and in fat about five times as much[3] Applying those figures to a whale with 25 per cent fat[4] at 2 4 atmospheres absolute pressure indicates the ability to eliminate rapidly and with safety 1 4 $(0\ 75 \times 1 + 0\ 25 \times 5) = 2\ 8$ per cent of its body volume of nitrogen About one third of the nitrogen in a whale s lungs could be safely dissolved in the tissues and rapidly eliminated

To introduce one third of the nitrogen of the lungs into the tissues would reduce the amount of gas in the lungs by one quarter, would require an increase in pressure of 2 4 times and would consequently diminish the lung volume to $\frac{1}{2\ 4} \times \frac{3}{4} = 0\ 28$ of the normal volume at atmospheric conditions

The next question is, whether the lungs could be compressed by hydrostatic pressure to the extent of much less than one quarter of their capacity The lungs of diving animals are not freely open to the exterior as in man The nasal orifices can be tightly closed, and the bronchioles (in the porpoise) are supplied with contractile tissue which can likewise effectively hold air in the lungs[5] The thoracic cross section is nearly circular and the intercostal and abdominal musculature is strong These structures could support great pressure, particularly if there were no movement of the supporting respiratory muscles But, if the intrathoracic pressure remained low, while the external hydrostatic pressure increased, there would only arise another problem of how to prevent the injection of viscera, blood and lymph into the thorax It seems likely that the pressure in the lungs would be close to the external hydrostatic pressure, and that most of the nitrogen in the lungs would be forced into solution in the blood and tissues

The whale's nitrogen capacity has been calculated at about 2 per cent of the animal's volume per atmosphere pressure Four atmospheres extra pressure would then cause the solution of all lung gases (provided that total collapse of the lungs occurs) and would still dissolve in the tissues only three times as much nitrogen as the human diver can rapidly eliminate The human safety

[1] Alec H Laurie, Discovery Reports, vii, 365, 1933

[2] L Hill, "Caisson Sickness and the Physiology of Work in Compressed Air," p 75 London, 1912

[3] *Ibid* p 171

[4] Alec H Laurie, *loc cit*

[5] G B Wislocki, *Am. Jour Anat*, xliv 47, 1929

limit is set as the critical pressure below which caisson disease does not occur, but many men have worked safely and endured rapid decompression at much higher pressures

It is simple to suggest that the average whale is as capable in this respect as even the exceptional human diver However, it is perhaps worth completing an argument which has been so often the cause of confusion The danger of caisson disease specifically occurs when nitrogen diffuses so rapidly from the tissues that the critical pressure for bubble formation is reached in the blood vessels To protect a man, the rate of diffusion is kept small by slow decompression which reduces the gradient of nitrogen pressure from tissue to lung The same result might be accomplished in the whale if the structure or composition of its tissues retards the rapidity with which nitrogen diffuses For example, it is often suggested that the layer of blubber, with its large nitrogen solubility and meager vascularization, would provide for a slow escape of the nitrogen dissolved at high pressure Corpulent human divers, however, are especially susceptible to caisson disease

On the other hand, it is quite reasonable to point out Haldane's view that increasing the rate of the circulation removes the blood from proximity with the source of nitrogen before the critical pressure for bubble formation is attained It is significant that the whale emerges from a deep dive with an oxygen debt and must maintain an active circulation of blood during the period of recovery The human diver emerges with no oxygen debt and yet sufficiently fatigued to desire the rest which will further slow his circulation The whale with an oxygen debt possesses likewise the essential conditions necessary for the specific stimulation of blood flow through the central nervous system[6] and therefore with the precise conditions which are favorable to the avoidance of nitrogen embolisms in the susceptible central nervous tissue

In reconsidering the situation in the diving whale, it is apparent that all the nitrogen contained in the lungs will be dissolved at about 4 atmospheres hydrostatic pressure, and that further submersion involves no greater physiological problem Even to dissolve this amount of nitrogen requires the total collapse of lungs and thorax, a difficult process to reverse But if it is possible and all the nitrogen is forced into solution, the amount present is still only three times as great as any human diver can safely eliminate During decompression, the circulation in the whale is bound to be accelerated by the stimulus of its large oxygen debt I believe that it is a conservative estimate that the whale's circulation would be three times as effective as the human diver's at the time of emergence from a deep dive

In view of the limited supply of nitrogen and the favorable conditions of the circulation there is no reason why a whale with ordinary mammalian respiratory and cardio vascular systems should be in danger of caisson disease Any special characteristics of the whale, such as peculiar amount and distribution of the fat and the retina mirabilia, had better be kept in reserve for the solution of other problems of cetacean physiology

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[6] W G Lennox and E L Gibbs, *Jour Clin Invest*, 11 1155, 1932

THE HELMHOLTZ-KOENIG CONTROVERSY

IN 1870 Helmholtz published results showing that when two notes are sounded on a siren there are waves set up which will produce resonance in tuned Helmholtz resonators Koenig repeated the experiment, using tuning forks and failed to produce vibrations in a third tuning fork which was tuned to the difference tone It is a well known fact that when two notes are sounded we hear beats whose pitch is the difference between the two original notes

The controversy which was argued pro and con for twenty five or thirty years was Are these tones which one hears due to a vibration or wave in the air or are they subjective tones? If there are waves in the air which produce vibrations in tuned resonators, strings or forks they are called combinational tones If these waves do not exist in the air the effects in the ear are called beat notes It seems that both sides of the controversy agreed as to the above distinction between combinational tones and beat notes There was no quibbling or haziness about definitions Present day writers often use the terms beat notes and combinational tones interchangeably Others seem to make a distinction between the two terms, but the distinction is a matter of pitch If the pitch is less than 16 or 30, perhaps, the term beat note is applied If more than 16 or 30 they are called combinational tones[1]

All experimenters who used sirens and kindred apparatus were thoroughly convinced that combinational tones were a reality All those who used tuning forks or piano wires as sources were convinced that there were no waves or combinational tones and that the effects were beat notes Helmholtz and his followers said Koenig and his followers were wrong Koenig and his group said that Helmholtz was wrong

Rucker and Edser,[2] using a siren as sources and a tuning fork as a detector, found combinational tones, but when their sources were tuning forks they say they did not find combinational tones However, they do

[1] Sutton SCIENCE March 8, 1935, p 255
[2] *Phil Mag*, 39 341, 1895

not seem to give much significance to this fact. They are sure there are combinational tones

Hazel[3] shows that both sides were right, experimentally, and that both sides were wrong, in that they did not recognize that there is an underlying fundamental principle of wave motion in the experiments

Koenig tried to add two sine waves and found nothing but the two parent waves Helmholtz modulated one wave or frequency with a second wave and found *combination tones* In Koenig's work the equation is, $A_1 \sin \omega_1 t + A_2 \sin \omega_2 t = ?$ Mathematically and experimentally, the only frequencies or waves found are the two original frequencies In Helmholtz's work we may assume that the output is affected by the air pressure in the common air chamber or that the output is proportional to $P \sin \omega t$ When two orifices in the siren are open, the pressure at orifice No 2, say, is $P_0 + P_1 \sin \omega_1 t$ (the pressure varies in unison with the frequency of orifice No 1) Then the output is, $(P_0 + P_1 \sin \omega_1 t) \sin \omega_2 t$ Thus we have a "product term" The "product term" is shown by mathematics to be two frequencies, the difference and the sum of the two parent frequencies

Hazel has shown that in every case when the "product term" is present we find combinational frequencies These combinational tones or frequencies or waves are real waves which can be detected by tuned apparatus

With the simple addition of waves these combinational waves are not present, and in the case of sound we have beat notes in our ears However, if the two frequencies or waves are added through non linear apparatus we have a "product term," and the combinational waves are found In the case of sound, since we hear beat notes, the logical conclusion is that our ears are non linear

Hazel's work clears up the prevailing hazy conceptions of addition and modulation of waves and shows that the two operations are not the same and that they are fundamentally different

The case of beat notes is somewhat the reverse of the physiological question "If a tree falls in the center of a vast forest where there is no animal life, is there any sound?" Physicists will agree that there are waves in the air There are waves but no ears With beat notes there are ears but no waves—no air waves whose frequencies are the frequencies of the beat tones heard

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GONADECTOMY AND A NEW SECONDARY SEXUAL CHARACTER IN FROGS

AN extraordinary and entirely new secondary sexual character in tailless amphibians has recently been described by Dr C C Liu, of Soochow University[1] This structure, the morphological relationships of which are fully described by its discoverer in a recently published paper,[2] consists of a band of connective tissue extending the entire length of each layer of the Obliquus muscle, at both their dorsal and ventral borders In certain species at least, the ventral bands are continued inward toward the midline at certain of the inscriptiones tendinae These bands have been named the *Lineae Masculinae* As with many other sex limited modifications in Amphibia, the functional significance of these structures is not immediately apparent The most obvious assumption—that they are concerned with the mechanics of voice production—is rendered doubtful by their complete absence in many species that are excellent singers They are found, among other species, in sexually mature males of the common American and European ranids, but are lacking in the bufonids of these regions, and are not found in females of any species Parker[3] has erroneously stated that they are confined to the two species of *Kaloula, borealis* and *manchuriensis* Liu has been able to show that they occur in a great many species of the frogs and toads of the world

It is curious that the presence of a structure as sharply defined as this should have escaped observation until now, particularly in an animal that has been subjected to the minute and continuous scrutiny that has been applied to the frog Once seen, the lineae masculinae are immediately apparent when a male frog has been skinned Thousands of students must have observed them unconsciously in American and European laboratories That they should have escaped the searching eyes of the German anatomists of the last century is still more remarkable Only the chance combination of a transparent skin and almost complete lack of sexual dimorphism in the Chinese frog *Kaloula borealis* revealed them to Liu From this starting point he has traced them through the Salientia of the world

The restriction of the lineae masculinae to one sex suggests a correlation of some kind between them and the gonadal hormones Their absence in sexually immature animals and an apparent lack of seasonal variation are also significant As a rule, sexual dimorphism in frogs and toads is not great The most obvious sex limited characters are the growths, asperities and glandular accretions which have achieved

[3] *Phil Mag*, p 103, January, 1935

[1] C C Liu, "Secondary Sex Characters of Chinese Salientia" Thesis, Cornell University, 1934 (abstract, 6 p)

[2] C C Liu, "The 'Linea Masculina,' a New Secondary Sex Character in Salientia." *Jour Morph Physiol*, 57 131–145, 1935

[3] H W Parker, "A Monograph of the Frogs of the Family Microhylidae," London: British Museum, 1934

such an extraordinary diversity among these animals[4] In addition, as might be expected, those species which have been intensively studied have been found to show more or less minute sex-correlated differences in nearly every detail of their anatomy Experimental work on salientian secondary sexual characters has been for the most part confined to those found in easily obtained American and European species of the genera *Rana* and *Bufo*, and the characters which have been available for experimental analysis are singularly uniform and conservative when compared with the bizarre developments seen in many exotic species With the exception of the vocal sacs, which Champy believes are self differentiating,[5] and the accessory reproductive apparatus (Mullerian ducts seminal vesicles) which have long been known to be under the control of the hormones in their post pubertal development the characters which have been available for study are seen to be integumentary modifications Numerous experiments have definitely established that these structures depend upon the sexual hormones not only for their initial development, but also for their conservation Occasionally museum collections yield specimens among exotic species that are undergoing sex reversal, and the condition of the secondary sexual characters in these individuals indicates that the mechanism governing integumentary modifications is uniform throughout the Salientia While it is impossible to forecast the nature of the supposed correlation between the linea masculina and the gonads it is immediately apparent that its morphological expression is basically different from the relatively superficial structures represented by nuptial pads and other modifications of the integument The potential importance from the sexual standpoint, of the discovery of this sharply defined structure in a standard laboratory type is evident Scarcely less interest attaches to its functional significance and its curious absence in bufonids and other groups

In an attempt to determine the nature of the supposed relationship between the linea masculina and the gonads, a number of leopard frogs (*Rana pipiens* Schreber) were gonadectomied during the months of April and May, 1934 An additional series maintained under identical conditions served as controls The gonads were removed surgically through the customary single abdominal incision, which was sutured with a couple of stitches to prevent prolapse of the viscera Recovery was rapid and complete, except in those animals that were heavily parasitized or were subjected to undue operative shock The frogs were maintained in excellent condition by regular feedings of cubed beef liver about every third day The importance of maintaining experimental animals in a healthy condition, as well as of making a careful examination for regenerated testicular fragments has been strongly emphasized by Champy (*loc cit*) Eight completely castrated males survived operative shock and parasitization They were killed for observation along with controls, at irregular intervals between 30 and 163 days In each case a careful examination was made for indications of regenerated testicular tissue suspected fragments being subjected to histological examination Although there was some regeneration of minute nodules of fat, in only one case was a fragment of testis found Two specimens were retained for 152 and 163 days respectively before they were killed At this time the autopsy revealed that the bands were still fully developed in both operated animals and controls Histological examination which shows that the bands are composed of dense white fibrous connective tissue likewise failed to show any castration effects Results were also negative in males that had been retained for shorter intervals before they were killed and the linea failed to develop in a small series of females from which both ovaries had been removed

The negative nature of these results is not surprising, since the linea masculina obviously forms a part of the basic supporting structure of the body, and experimental work on other vertebrates has shown that many deeply seated somatic differences are not dependant on the sexual hormones for their conservation, once they are fully established They are of considerable interest in showing the relation between this new secondary sexual character and those sexual characters in frogs that have already been studied so intensively Two conclusions may be drawn from the results outlined above (a) Although the testicular hormone may be necessary for the initial development of the linea masculina, it is not necessary for its conservation and (b) the linea masculina is not potentially present in both sexes in the adult stage, as Zahl and Davis found to be true of the caudal ocellus in *Amia*[6] Several other possibilities remain The bands may possibly attain somatic expression entirely independently of the gonadal secretions, as Champy found to be true of the vocal sacs although this hardly seems likely in view of the apparent time correlation between their appearance and the onset of the testicular hormone The true nature of the relationship may be revealed by additional castration experiments or by

[4] G K. Noble, "Biology of the Amphibia," Chap V, 1931

[5] C Champy, "Les caractères sexuels considérés comme phénomènes de développement et dans leurs rapports avec l'hormone sexuelle," Paris, 1924, p 107

[6] P A Zahl and D D Davis, "Effects of Gonadectomy on the Secondary Sexual Characters in the Ganoid Fish *Amia calva* Linnaeus," *Jour Exper Zool*, 63 291–307, 1932

heterosexual gonad transplants Further experiments along these lines are being conducted

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A CHAT

I HALTED to peruse a piece of modern commercial advertising and was excited by it It was a neat pamphlet, entitled "———— News Chats," which is periodically published and circulated by one of our huge concerns whose business is the sale of scientific laboratory supplies It announces itself as being "A bulletin of newsy information to those who know us well and an introduction to those who do not, who we hope will become our friends and customers"

Allow me to reproduce the titles found on some of the articles in the last issue—October, 1934—of this genial monthly visitor from the land of trade to the desks and minds of us lords of American science

Thar's Sillimanite in Them Thar Hills
A Field Trip in the Classroom
A Hole in a Black Derby Hat
Fitting Trees to the Soil
Black Light from Sunshine
Now Liquids Are Polished
Lots of Agitation for a Little Money
Keeps Storage Batteries Healthy
On the Lookout for J Pluvius

Furthermore, grant me liberty to quote, with briefest comment, several sentences from these articles—so cleverly and intimately, not to say adroitly, named!

> Just being out of doors in the bright sunshine is stimulating, but the most excitement comes in searching out interesting insects and animals to see how they *build their homes and raise their children*

> "'Chose qui plait est a demi vendu,' runs the French saying a thing that pleases is half sold—a truth we all must admit"—To be sure

> "Stranger, that 40 over yonder is the finest hardwood soil you ever want to see"—Yessiree!

> "Light, the intangible something that enables us to see things and promotes the growth of plant and animal life, was so much a mystery to ancient mankind as to be deified in some form in almost all of the earlier religions" —Startling information!

> "The value lies in the 'eye appeal' which leads prospective buyers to choose one in preference to the other" —I see

> "Only a *healthy*, active storage battery gives its owner a normal period of service"—Honestly?

However, if blame there be for this infantilism in these high places, do not suspect that I lay it upon the publisher He has a business, and must chat accordingly This must be a proper approach—effective and profitable—to his audience, else, having tried it, he would not continue it The great analyzers themselves are analyzed The business sense has an instinctive power of psychological insight that amounts to wizardry We are to believe that the "———— News Chats" is a shrewd, welcome and successful adaptation, in the tough realm of competitive trade Why not?

The average scientist, even the super scientist, of the present day does likewise, as his turn comes to sell, so to speak, his products to his customers—the public and the world It is the vogue He cleverly composes his material, cites the business man or else Lewis Carroll as his justification, and then goes out talking folk lore, even baby dialect, quite naturally and congenially He acquits himself most adorably before 'The Boy Scouts," 'The Ladies Better Fed Club," "The Tradesmen's League Against the Spinning Wheel" and other advanced organizations whose members are simply spoiling for enlightenment in the black magic of all the sciences Yes, let a second and living Jacques Casanova call to day upon a second and living Voltaire, and the latter mention some popular modern scientist—as he mentioned on that past day the name of Count Algarotti, the prominent Venetian scientist—and Casanova would be obliged to repeat his famous comment 'That is how he made his name He constituted himself an admirer of Newton, and made it possible for the ladies to talk learnedly about light"

Though long neglected and out of use, the amazing pedagogical potency of "chat" or the "chatter" method has been rediscovered and re employed I am informed that scientific causerie is again very prevalent, even in the erotic wit of the best social circles They say it is not unusual there, in these days, to hear sweet and burning passion vent itself and forward its cause in language such as the following "In compound ratio of your affection," "In inverse ratio of my languor," "The mass multiplied by the velocity of my attendance equals the momentum of your passion," "The squares of the times of my hope are as the cubes of the distance of your consent" and so forth—quotations from a French work on Italy, in the second half of the eighteenth century Sciencized gallantry—what can't science achieve, once it dismounts from its high horse!

And so, to chat Just folks, all around, just one big chatting family Shan't we just sit down now, all together, and enjoy a little chat over a "true black body" or, what amounts to the same, "a hole in a black derby hat hung from a hook on a surface covered with black felt"?

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SCIENTIFIC BOOKS

INEQUALITIES

Inequalities. By G. H. HARDY, J. E. LITTLEWOOD and G. PÓLYA. Cambridge, England, The University Press; New York, The Macmillan Company, 1934. pp. xii + 314. $4.75.

THIS book is devoted to a systematic and critical study of a number of inequalities which are fundamental in mathematical analysis, and to the presentation of a wealth of others which the authors have encountered in their wide experience, many of which have been subjects of their own investigations. It is unique in its field for many reasons, but especially on account of the great variety of results presented and the thoroughness with which the inequalities have been analyzed and generalized. Mathematical investigators will find it an indispensable source of information.

Most mathematicians regard inequalities as auxiliary in character and would perhaps not think of them as constituting a domain of principal interest apart from applications. In reading the book it is a pleasant surprise, therefore, to find that the theory of inequalities is a fascinating subject in itself, and to see how effectively the theory may be systematized and correlated by skilful analysts. The authors have achieved much in this regard and the results of their efforts indicate the possibility of still further interesting correlations in the future. Their plan is outlined in excellent fashion, with regard to both content and method, in Chapter I, which concludes with some helpful advice to the reader who may be interested in principal results rather than details.

Chapters II–VI contain a systematic theory of generalized arithmetic and geometric means and the relationships between them. The very important inequalities usually designated by the names of Holder and Minkowski appear as special cases of these relationships. For a finite number of variables the inequalities are treated in Chapter II, for a denumerable infinity of variables in Chapter V, and for functions and integrals in Chapter VI. Chapter III is one of the most interesting in the book. It contains a theory of still further generalized means in which the special function $\phi(x) = x^r$ appearing in the original definition of the authors is replaced by a strictly monotonic function $\phi(x)$. Chapter IX is auxiliary in character, devoted to the explanations of various devices from the calculus useful in deducing inequalities.

In words of the authors "the rest of the book (Chs. VII–X) is written in a different spirit and must be judged by different standards. These chapters contain a series of essays on subjects suggested by the more systematic investigations which precede. In them there is very little attempt at system or completeness. They are intended as an introduction to certain fields of modern research, and we have allowed our personal interests to dominate our choice of topics." Thus Chapter VII is devoted to the proofs of a variety of special integral inequalities which are related primarily by the interesting fact that they can all be established by means of the theory of the calculus of variations.

The material in Chapter VIII has to do with multilinear forms in n sets, each containing a denumerable infinity of variables. For convenience here we may agree that such a set of variables x_i defines a point in a Holder space if a sum $(\Sigma|x_i|^p)^{1/p}$ with $p > 0$ is finite. The chapter begins with a very general theorem specifying an upper bound for a multilinear form whose variables define points in Holder spaces related to each other by suitable conditions on the exponents p. The theorem has numerous interesting applications. In the latter part of the chapter bilinear forms with $n = 2$ are more intensively studied. Properties of bounded bilinear forms are deduced, two special bilinear forms of Hilbert are discussed and a "convexity theorem" of M. Riesz for bilinear forms is developed and applied. Chapter IX is devoted to an important theorem of Hilbert giving an upper bound of the special bilinear form $\Sigma x_i y_k/(i + k)$, with analogues for integrals and with numerous modifications and extensions.

Chapter X contains theorems concerning rearrangements of two or more sets of non-negative numbers, and corresponding theorems concerning rearrangements of functions. A fundamental theorem for two sets $(a_1, \ldots, a_n)$ and $(b_1, \ldots, b_n)$ is that the sum $\Sigma a_i b_i$ is greatest when the notations for the sets are so chosen that the elements of both sets are increasing (or decreasing) in magnitude, and least when their elements vary monotonically in opposite senses. There are similar theorems involving an arbitrary finite number of sets. Departing for a moment from the language of the authors we may define a rearrangement of a function $\phi(x)$ measurable on $0 \leqq x \leqq 1$ as a second function $\bar{\phi}(x)$ such that for every pair of values y_1 and y_2 the measure of the set of points x at which $y_1 \leq \bar{\phi}(x) < y_2$ is the same as that of the corresponding set for $\phi(x)$. A non-negative function $\phi(x)$ integrable on $0 \leqq x \leqq 1$ has a decreasing rearrangement $\bar{\varphi}(x)$ uniquely defined almost everywhere. The theorems concerning rearrangements of finite sets have analogues for functions $\phi(x)$ when sums are replaced

by integrals and monotonic rearrangements of sets by decreasing rearrangements $\bar{\varphi}(x)$.

In this connection a paper by Haskins[1] should be mentioned, which seems to have escaped the attention of the authors. Haskins defined (p. 184) the "momental constants" of a bounded measurable function $f(x)$ on an interval $a \leqq x \leqq b$, which except for a constant factor are somewhat specialized cases of the means $\mathfrak{M}_r(f)$ of Hardy, Littlewood and Pólya. He showed (p. 185) that the values of these constants are characteristic of the class of rearrangements of a function, as defined in the last paragraph above, and describes (p. 194) the increasing rearrangement of a function as typical of the class. Furthermore he proves (p. 189) that the means $\mathfrak{M}_r(f)$ have the effective upper and lower bounds of the function $f(x)$ as limits when r approaches $+\infty$ and $-\infty$, respectively. These results are very closely related to some of those given in the book here reviewed. I understand from Professor Haskins that the paper by Schlömilch, referred to in the book, was not available to him in the war-time year, 1916, when his paper was written. Schlömilch's paper deals with similar conceptions for continuous functions and Riemann integration.

No description of the book here reviewed would be complete without mention of the very valuable lists of theorems and examples at the ends of the chapters. If proofs were given for all these results the book would be expanded beyond reason, but in most cases the necessary arguments are clearly indicated or references are cited. This is only one of many features which insure the great value of the book as a contribution to our modern mathematical literature.

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BIOLOGY FOR EVERYMAN

Biology for Everyman. By SIR J. ARTHUR THOMSON. Two volumes; pp. 1561. New York, E. P. Dutton and Company. 1935.

AMONG the biologists living during the last fifty years, perhaps no one has had such wide and diversified interests as the late J. Arthur Thomson. It must be at least forty years ago that a reviewer, contemplating one of his comprehensive works, expressed doubt concerning the possibility of covering so wide a field. He said that he was quite willing to concede that professors knew more about these matters than any one else, and that of all professors, Scottish professors knew most, and yet, after all, what were the limitations of the human mind? At a later date, it was Thomson himself who, in his charming little book on Herbert Spencer, commented on a result of that philosopher's universality; "we can hardly picture the man who has not some crow to pick with Spencer." So it must be, yet with our scientific babel of tongues, it is a saving grace that there are some, if only a few, who can approximate to a universal language and give us an understanding of the whole drama of life, rather than isolated fragments. In attempting to do this, there are two possible methods. One is to condense and simplify, describing vital phenomena in general terms, but not discussing details. Huxley knew how to do this to perfection. But this synthesis, to be rightly appreciated, must rest on a background of knowledge previously acquired. The other method, followed in the book now reviewed, is to describe details in such a manner as to give a vivid impression of living things in all their diversity, while at the same time constantly recurring to the underlying philosophy which relates them to a whole. The reader is stimulated and delighted to discover how much of interest is going on in this world of nature, indeed, in his own immediate vicinity; so much to observe and enjoy which he has not hitherto noticed. Yet as the Reverend Wm. Kirby, famous pioneer entomologist, said over a hundred years ago, all these things can be seen to illustrate the wisdom and goodness of God. We probably do not express ourselves in theological terms, but it comes to much the same thing if we say that we perceive the harmony and unity of nature, the marvelous creative power which we describe as evolution. So we are alternately, or almost simultaneously, analytic and synthetic, guided by the feeling which Tennyson tried to express in his poem on the "Flower in the Crannied Wall." Sir Arthur Thomson knew well how to set these matters forth in interesting languages for the most part intelligible to any educated person. His book is extremely "readable." But neither Thomson nor any one else can simplify biology in such a way as to excuse the reader from any intellectual effort. In truth, we are dealing with the most complex and marvelous phenomena in the universe and those who have grown old in their investigation still feel like beginners. It is this eternal freshness of biology that constitutes one of its principal charms, for those who care to think.

It is encouraging to note that throughout this country there is an increasing interest in biological subjects, an impetus which, when given sufficient opportunity for development, may carry us far. Thomson, in his concluding chapter, sums up the reasons for being interested in biology, as follows:

(1) Biology can spread our table and increase the amenities of life, ameliorating the struggle for existence,

[1] On the measurable bounds and the distribution of functional values of summable functions, *Transactions* of the American Mathematical Society, vol. 17 (1916), pp. 181–194. See also Jackson, *ibid.*, pp. 178–180; Van Vleck, *ibid.*, vol. 18 (1917), pp. 326–330.

(2) It can conquer disease and help towards an increase of positive health

(3) It can offer good counsel to help man to meet some of the perennial problems of life

(4) It has a manifold cultural value

(5) It affords a basis for eugenics

(6) It is full of ethical suggestiveness

(7) It has contributions to make toward a sound philosophy

Therefore, he says, let us have more biology

Although the two volumes contain over 1,500 pages they necessarily leave very much unsaid and if the book is widely read, as it is certain to be, it should stimulate the production of other works along similar lines One can imagine books dealing with special groups of animals or plants, or special types of behavior, or with the natural history of particular regions Also, Thomson's book itself is likely to appear in several editions It did not get the final revision it might perhaps have had, if the author had lived to see it through the press, and there are naturally some errors to be corrected It would be tiresome to try to enumerate all these in a review, but one or two may be cited as examples The reference (p 1369) to Pleistocene fossil tsetse flies originated in a mere blunder in a very excellent work and has been uncritically quoted The *Hybernia* moth (p 869) is cited as a butterfly, evidently because the facts were taken from a German work, which uses the same word for moths and butterflies The giant cactus (*Carnegiea*) is said (p 1180) to inhabit Texas The accounts of fish scales are misleading, not distinguishing between the circuli and annuli It would be worth while, for the purposes of the next edition, to submit the various chapters to specialists, and so far as possible eliminate these minor errors They do not much affect the book as a whole, but as they are discovered, they undermine confidence Furthermore many of the illustrations could be much improved, and some additional ones would be valuable The printers and publishers must be congratulated on producing so large a book with hardly any misprints

T D A COCKERELL

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR DEMONSTRATING THE OERSTED EFFECT

THE magnetic effect of an electric current is usually demonstrated by bringing a current carrying wire into the neighborhood of a compass needle, after the manner of Oersted's original experiment Convection currents, *e g*, those carried in electrolytes or in gases are capable of producing the same effect, but this is not often shown explicitly

In the belief that it might be advantageous to emphasize the fact that a conduction current in a wire *i e*, one borne by charged particles of one sign moving in one direction, is essentially equivalent in its external magnetic action to electrical convection currents, in which particles of opposite sign move in contrary directions, the following simple apparatus was constructed A straight wire (W), a long electrolytic cell (E) and a Geissler tube with a straight central capillary (G) were mounted on a wooden base, as shown in Fig 1 A shallow cylindrical depression under the center of each unit accommodates an ordinary magnetic compass The electrolytic cell is merely a piece of 8 mm glass tubing bent to the appropriate form, and may be filled with a solution of cupric sulfate Ordinary copper wires whose ends are twisted into small spirals serve as electrodes The discharge tube may be any long I tube usually available in the laboratory Single pole knife switches mounted on the base control the current through the wire and cell, while the electrodes of the Geissler tube are connected directly to the secondary of a small induction coil

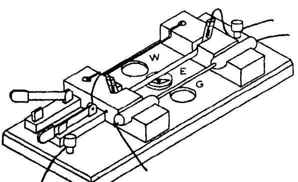

FIG 1

A convenient method of connecting the source of current—a six volt storage battery—to the remainder of the apparatus is shown in Fig 2 This arrangement

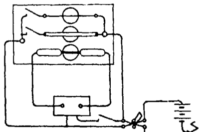

FIG 2

makes it possible to demonstrate the three units in rapid succession One reversing switch serves to change the direction of the current in any unit An inclined plane mirror clamped above the apparatus makes the effect visible to a large class

Ira M Freeman

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AN INEXPENSIVE APPARATUS FOR THE MEASUREMENT OF BODILY ACTIVITY

It is at times important to obtain objective records of the bodily activity of animals without great expense and yet by means of a sensitive instrument The following apparatus has been used successfully with young puppies and may be adapted to larger or smaller animals

A small light aluminum baking pan 11″ × 7″ × 1½″ (see a in Fig 1) was suspended within a packing box

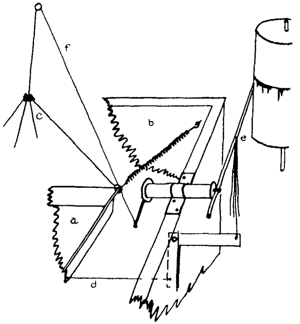

Fig 1 Detail showing method of wiring used in apparatus for measurement of bodily activity (a) aluminum pan, (b) packing box, (c) wire rods from corners of pan, (d) thread from side of pan to lever, (e) writing arm with threads attached, (f) thread from upright wires, leading to writing arm

(b) (approximately 2 feet long, 16 inches wide and 1 foot deep) by means of small springs, one attached at each corner of the tray, and to eyes screwed in the corners of the box These eyes were so arranged that they could be adjusted to various heights, depending on the weight of the animal Four light wire rods (c) projected from each corner of the tray to meet above its center

In order to secure a single record from all movements of the tray, heavy threads (d) were attached to it, one on each side By means of pulleys these threads converged at a series of levers amplified 3/2, and from the levers threads were connected to a writing arm (e) bolted to a bicycle bearing

A thread attached to the upright wires from the corners of the tray, which converged above it, was arranged by pulleys in such a way (f) as to pull downward on a lever attached to the bicycle bearing opposite to the writing arm This lever was bolted so as to make it adjustable to the weight of the animal Thus, with the tray under slight tension on all sides and with respect to gravity, movement in any direction resulted in a downward pull of the writing arm

If the animal studied is very active, it may be confined within a ventilated box, which may be placed in the tray, or the box itself may be wired in the way described

The apparatus has proved sufficiently sensitive in the case of puppies to record practically all movements of skeletal musculature

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A SENSITIVE A-C VACUUM TUBE RELAY

A vacuum tube relay possesses numerous advantages in the temperature control of laboratory apparatus which outweigh the slight increase in the complexity of the system The reduction of the current which passes through the mercury regulator from ten or a hundred milliamperes to the few hundredths of a milliampere required by the vacuum tube practically eliminates all sparking at the mercury contact and makes the presence of moderate amounts of dirt or oxides in the mercury surface a matter of no consequence This results in a twofold advantage first, special precautions as to purity of the mercury are unnecessary, and second, the regulator will in general give trouble-free service for longer periods of time

A vacuum tube relay circuit is described by Rosenbohm[1] requiring a storage battery for the vacuum tube filament current supply and dry batteries for plate and grid voltages Korpiun and Geldbach[2] show a circuit for operating a similar device with batteries or 220 volt alternating current supply, using two triodes Both of these systems have certain disadvantages, the first requires a relatively large investment in batteries

[1] E Rosenbohm, *Proc Acad Sci Amsterdam*, 35 876, 1932

[2] J Korpiun and Alfred Geldbach, *Z Electrochem*, 39 755, 1933

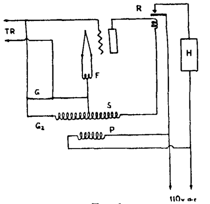

FIG 1

and occasional interruptions of service for recharging the storage cells, and the second is relatively complex and requires the manufacture or purchase of a number of special resistances

The author feels that a description of the simple a c relay developed in this laboratory will be useful to others requiring a sensitive relay for temperature control or other purposes The circuit is shown in the accompanying diagram The relay consists of a "45" power amplifier vacuum tube, a Leach No 1305 a c relay (R), two resistors (G_1 and G_2) and a transformer with a 110 volt primary (P), a 660 volt center tapped secondary (S) and a 2 5 volt center tapped filament supply winding (F) (Inca transformer, type C 31) TR is the mercury thermoregulator and H is the thermostat heating element The only electrical supply required is 110 volts a c The power consumption (exclusive of H) is 35 to 40 watts The resistors G_1 and G have the values 2 and 7 megohms, respectively The parts for the relay are commercially available and inexpensive

A relay similar to the above has given nearly two years of trouble free service, regulating the temperature of a covered water thermostat to ± 0 002° C and another is controlling the temperature of an open stirred water bath at 25° ± 0 01° C

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SPECIAL ARTICLES

ON THE GRAPHIC REPRESENTATION OF IONIC EQUILIBRIA IN BLOOD SERUM

DURING the session of 1915–16 I made a study of ionic equilibria in sea water of 2 3 millimols per liter alkaline reserve, and plotted the results on log log paper [1] Log [H⁺] was measured on the x axis and log CO_2 pressure (later reduced to mm of mercury) on the y axis During the session of 1916–17 I plotted similar values for blood serums, but in this case the alkaline reserve (bicarbonate), titrated in a rotating hydrogen electrode vessel, varied from sample to sample, so distinguishing marks were used for each sample in marking the values on the log log paper and it was found that the values of bicarbonate formed a logarithmic scale on an axis at 45° to the x and y axes [2] Later I learned of the mathematical treatment of this subject by Hasselbalch[3] and applied the equation

$$[H^+] = k \frac{pCO_2}{[BHCO_3]}$$

to that point on each graph where $pCO_2 = [BHCO_3]$ and hence $[H^+] = k_2$ and $pH = pk_2$ (denoting log of reciprocal of k_2) It was found that pk_2 of sea water was 7 08 at 0°, 7 20 at 10°, 7 32 at 20° and 7 44 at 30° at the points where $[BHCO_3] = pCO_2$, but inspection of the graph showed that k_2 varied slightly with CO_2 pressure Whether this was due to partial change of $BHCO_3$ to B_2CO_3 with fall of CO_2 pressure or due to experimental errors was not determined In case of blood serums it was thought that errors in titrating $[BHCO_3]$ would be greater at lower values, and with the higher values $pk_2 = 7 5$ at 20° From the data on sea water it seems evident that pk of blood serum would be at least 0 12 higher at 38° than at 20° and so a value of $pk_2 = 7 62$ might be guessed at Preliminary attempts at determination of k at 38° showed varying results and were interrupted by my entrance into military service, and after the war I constructed log log pH graph paper on three axes at angles of 60° with each other and posted it in the laboratory for the class in physiological chemistry Since then many papers have appeared on ionic equilibria in blood and new values of the standard hydrogen electrode higher than those used by Sorensen have been used

Hasselbalch and most later workers instead of titrating $[BHCO_3]$ of serum, added acid and pumped out the CO_2 and measured it and calculated $[BHCO_3]$ and, instead of using pCO_2 in an equation, first calculated the CO_2 physically dissolved in the serum, calling it "H_2CO_3," using two constants k' and c where $k'c = k_2$

$$[H^+]_s = k'c \frac{pCO_2}{[BHCO_3]_s}$$ [4]

where $c = 0 0591\alpha$ [5]

[1] Publication No 251, Carnegie Institution of Washington, p 36, Fig 6, 1917

[2] *Jour Biol Chem.*, 519 522, Fig 1, 1917

[3] *Biochem. Z*, 78 113, 1917

[4] L J Henderson, "Blood," New Haven (1928) equations 6–7, p 42

Earlier workers used Bohr's value of $\alpha = 0.541$ at 38° in which case $c = 10^{1.495}$, whereas most recent workers have used Van Slyke, Sendroy, Hastings and Niel's[6] value of α of 0.51 at 38°, in which case $c = 10^{-1.92}$. Hastings, Sendroy and Van Slyke[7] reviewing recent literature found pk′ averaged 6.104, using Bohr's α, and 6.13, using their own value of α. *In either case* $pk_2 = 7.625$. If, however, the value given in their summary of $pk' = 6.10$ is used, pk_2 becomes 7.62. *Since the value of α is not the same for all serums it seems of advantage to use k_2 in place of $k'c$ and plot quantities that can be directly determined: i.e.*, pH, pCO$_2$ and [BHCO$_3$]. Hence I have redrawn my log-log-pH paper with $k_2 = k'c$ of Hastings, Sendroy and Van Slyke, and reproduce it here (Fig. 1).

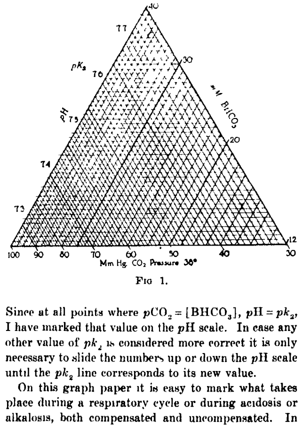

FIG 1.

Since at all points where $p\mathrm{CO}_2 = [\mathrm{BHCO}_3]$, $p\mathrm{H} = pk_2$, I have marked that value on the pH scale. In case any other value of pk_2 is considered more correct it is only necessary to slide the numbers up or down the pH scale until the pk_2 line corresponds to its new value.

On this graph paper it is easy to mark what takes place during a respiratory cycle or during acidosis or alkalosis, both compensated and uncompensated. In health and comparative rest the values of the blood fluctuate around the center of the chart, being in the arteries above and to the right of the center and in the veins below and to the left of the center. Under extreme conditions the values may go beyond the range of the graph. For example, in order to remove the compensating action of the respiratory center a cat was put under artificial respiration, and when this was markedly increased, the values for arterial blood moved off the graph upward and to the right, whereas the values for the veins remained nearer the center. When the maximum rate of the artificial respiration apparatus was reached an attempt was made to blow more CO_2 out of the blood by removing the surface layer from the base of the lungs with sandpaper and blowing a continuous stream of air through the lungs. The same result was obtained, the venous blood remaining near its normal value. The explanation of this was found in observing the output of the heart. When the respiratory center was put out of action the center or centers controlling the circulation (vasomotor and vagus centers?) regulated the blood and, although the arterial blood was very deficient in CO_2, the blood moved so slowly through the capillaries that its normal CO_2 content was restored.

Since the arterial blood is spread over 125 sq. m. of surface in contact with alveolar air in the lungs, it is safe to assume that the CO_2 partial pressure in the alveolar air is as close to that of arterial blood as could be determined in any ordinary apparatus. Although the partial pressure is not uniform in the different alveoli, the mixed alveolar air should be very close to the mixed arterial blood in CO_2 partial pressure and hence at 38° these three values of pH, CO_2 pressure and bicarbonate concentration may be determined in relation to the arterial blood taken from the living subject with precautions against loss of CO_2 in the sample. In venous blood, however, it seems to me that the CO_2 pressure is the most difficult to determine and it is better to determine pH and [BHCO$_3$] and find pCO$_2$ on the graph.

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[5] Peters and Van Slyke, "Quant. Clinical Chem.," 1: 878, equation 11, 1931.

[6] *Jour. Biol. Chem.*, 78: 765, 1928.

[7] *Jour. Biol. Chem.*, 79: 183, 1928.

SEXUAL PHASES IN PROSOBRANCH MOLLUSKS OF THE GENUS CREPIDULA

PROTANDRY, proterogyny, true hermaphroditism and, occasionally, self-fertilization have long been known to occur in Gastropods. In this group the species of *Crepidula* are of special interest, however, because in *C. plana*, which is normally protandric, it has been thought that the association of the young animal with an older individual, particularly one in the female phase, is essential for the development, as well as for the maintenance, of the functional male phase.[1] In another species, *C. fornicata*, which is likewise protandric, the length of time which the animal spends in the male phase was believed to be correlated with its continued opportunity for insemination.[2]

[1] Harvey N. Gould, *Jour. Exp. Zool.*, 23: 1–69; *Jour. Exp. Zool.*, 23: 225–250, 1917.

In both these species, as well as in *C convexa* nearly all individuals pass through a functional male phase while very young, often before the body has attained more than a small fraction of its normal definitive size, as was observed by Conklin many years ago[3]

The male phase is followed by a series of transition stages, during which the long muscular copulatory organ and the seminal vesicles are absorbed Meanwhile the remaining spermatogenic cells of the gonad are cytolyzed leaving only empty follicles with such ovogonia and ovocytes as were formed in the primary bisexual gonad of the very young animal In the later transition period proliferation of ovogonia and growth of ovocytes accompany development of the uterus and seminal receptacles characteristic of the functional female phase as Gould has so fully described [1]

The two functional sexual phases are thus separated by a more or less extended transition period during which neither sex is dominant since the animal returns essentially to a state of sexual immaturity The phases are strictly progressive however for the transition gonad invariably develops into an ovary

In some cases the male phase may be aborted so that functional sexuality is not realized until the final female phase appears Some individuals too show a tendency to remain in the male phase much longer than others Since this strongly male characteristic is associated with smaller and fewer ovocytes in the gonad it is thought to be due to a different combination of genetic factors than is present in animals which show a more active and briefer male phase

This is not strictly a case of so called 'sex reversal it is merely the realization of the individual's genetic factors which lead first to the formation of the primary bisexual gonad then to the functional male phase followed by the transition stages and terminating in the full sexual maturity of the female phase

No satisfactory evidence has been obtained to show that this sequence can be altered experimentally although any one of the phases may be abbreviated or prolonged by various environmental conditions Nor does it appear that in *C plana* association of the young animal with older individuals although usual, is essential for the realization of the functional male phase Examination of hundreds of young individuals of that species which had attached themselves singly on dead shells of *C fornicata* showed that such isolated young evidently become as fully functional males as do those which are associated with large females Both the isolated and the associated young show much individual variability in the size that they reach before assuming the male phase, but the relative sizes are about the same in both environments

The length of time that the male remains functional is however, undoubtedly influenced by its environment as Gould[1] and Orton[2] have observed This fact is easily proved experimentally for *C fornicata* since in this species several individuals pile up in permanently attached groups usually making a graded series with the oldest at the bottom and youngest at the top The oldest has as a rule reached the female phase the younger transition phases and males being superimposed If these groups be separated and the functional males isolated or segregated the effects of the changed environment are very striking Most of the males respond by promptly entering upon the transition stages which lead to the female phase Spermatogenesis ceases the penis and seminal vesicles are gradually absorbed and the spermatogenic cells are cytolyzed Of more than 200 actively functional males which were thus segregated in June 1934 about 15 per cent had transformed to the female phase within 63 days 39 per cent had reached the third transition stage 22 per cent the second transition stage 12 per cent the first transition phase while only about 11 per cent had remained functionally male Of an approximately equal number of males of similar sizes which had remained in their normal associations it was estimated that not more than 3 per cent had reached the female phase during that time and only 12 per cent had begun the transition stages while fully 85 per cent still retained their function as males

This experiment might be interpreted as indicating that the females in the intact groups exercise some restraining influence on the normal progressive change of sexuality of the males or that they in some way stimulate the continuation of the male's functions but at least one other hypothesis should be considered It must be remembered that each of the males in question has long since become so firmly attached to the shell of the underlying individual that movements are normally limited to merely raising or lowering the shell sufficiently to allow a circulation of the water needed for respiration and nutrition When dislodged from their normal positions however the males struggle vigorously for hours or sometimes for days in efforts to right themselves and secure new attachments Some of them later resume active locomotion These active movements not improbably result in a more rapid metabolism which may conceivably initiate the first of the series of interdependent events leading to the sexuality of full maturity The animal is thus prematurely aged in the sense that the sexual phase normally characteristic of an older age group appears when the body is less than half as large as it might otherwise have been at the beginning of the female phase

[2] J H Orton, *Proc Roy Soc London* 81B 468–484, 1909, *Nature*, 110 212–214, 1922

[3] E G Conklin, *Jour Morph.*, 13 1–226, 1897 *Proc Acad Nat Sci, Philadelphia* 1898: 435–444, 1898

Change of sex under these conditions is merely the premature realization of the animal's definitive genetic characteristics

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PROTECTIVE VACCINATION OF HORSES WITH MODIFIED EQUINE ENCEPHALOMYELITIS VIRUS

By serial passage through pigeons a strain of equine encephalomyelitis virus of the eastern type has been so changed that it promises to be of value as a vaccine The pigeons were inoculated by the intracerebral route, under ether anesthesia, and the brain tissue for passage secured from birds that had just died or were killed when moribund The virus has been carried through 100 passages but most of the work to be reported was done with brains from the 40th and 49th serial passages

In order to secure more material than is provided by the pigeon brain, a young lamb was inoculated intra cerebrally with brain from the 40th pigeon passage and another lamb was likewise inoculated with brain from the 49th passage Both animals promptly de veloped encephalomyelitis and died Their brains were preserved in sterile 50 per cent glycerin and suspensions were made as needed for the experiments As little as 1 cc of a 10^{-8} dilution of a 10 per cent suspension of the brain of either lamb injected sub cutaneously into guinea pigs would immunize against from 10 000 to 100 000 infective doses of the unmodi fied virus injected either subcutaneously or intracere brally Of 117 guinea pigs inoculated with the 10 per cent brain suspension, 8 or 7 per cent, died with symptoms of encephalitis and all but 15 of the remain der were immune The majority of those that were not immune were tested by intracerebral injection of large amounts of virus Had they been tested by the subcutaneous route they would probably have lived

Although the modified virus usually fails to produce disease when injected subcutaneously, if it is brought directly into contact with the central nervous system an encephalomyelitis results Its activity following intracerebral injection is however, about 100 times less than that of the unmodified virus Intracerebral passage of the modified virus through a horse, calf, sheep, rabbit, and serially through five guinea pigs has not restored the lost property of invasion of the cen tral nervous system following subcutaneous injection

Under controlled laboratory conditions 11 horses have been inoculated subcutaneously with suspensions of the lamb brains mentioned above The majority of the animals were given 10 cc of a 10 per cent sus pension Not one horse developed a temperature nor could virus be demonstrated in blood drawn at various intervals after the injection With the assistance of Dr J H McNeil, state veterinarian for New Jersey, 67 horses were each given subcutaneous injections of 5 cc of the 10 per cent lamb brain suspension The inoculations were made in a region where there were many cases of encephalomyelitis, and two of the in oculated animals developed the disease The virus present in the one brain secured was highly virulent for guinea pigs and was evidently not the strain in jected The other 65 horses showed no reaction to the virus, except that many of those tested as well as all those inoculated at the laboratory developed neutral izing antibodies

Testing the immunity of horses is a difficult problem because the only certain method of producing disease in these animals is by the intracerebral injection of virus and only a horse with a very high degree of im munity can withstand such an inoculation Four out of nine vaccinated animals tested by this method showed no temperature reaction or other sign of in fection The other five animals, after an incubation period that was from one to two days longer than that in the controls developed the disease and died Two other vaccinated horses inoculated intravenously with virus showed no evidence of disease, but since only one of two controls was infected the results are not con clusive

In spite of the fact that more than half of our vac cinated horses died from a test intracerebral inocula tion we believe that vaccination with the modified virus will protect against the natural disease This belief is based on the results of the experiments with guinea pigs and on the facts that vaccinated horses developed neutralizing antibodies and that four horses became so highly immunized that they resisted the intracere bral injection of active virus

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SCIENCE

VOL 81 FRIDAY, JUNE 14, 1935 No 2111

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City Grand Central Terminal
Lancaster, Pa Garrison, N Y
Annual Subscription, $6 00 Single Copies, 15 Cts

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

BOTANY AND HUMAN AFFAIRS[1]

By Dr A F WOODS

UNITED STATES DEPARTMENT OF AGRICULTURE

"BOTANY and Human Affairs" is a rather broad subject to present in twenty five minutes But I am advised by Director Gager that various special phases will be discussed in detail by other speakers, so that I may confine my remarks to a more general treatment of the larger aspects of the subject, creating, if you please, a background for the real pictures to come later in this program

All animals, including man, are dependent for food directly or indirectly on some form of green or chlorophyll bearing plant life The study of these organisms, that make man's life possible, is of as great fundamental importance as the study of man himself

Botany in its broad sense is the systematized knowledge we possess of the vegetable kingdom as a whole It includes all that is known about plants, their history through the ages, as we get it in geology and paleontology, the description and classification of all known forms of living plants, the study of their origin, life relationships and development (embryology, genetics), their structure, (histology and cytology and morphology) their physiology, their composition, modification, mutation and evolution, their cultivation, propagation and breeding, their diseases, their relation to each other and to other organisms and to the factors of their environment From the economic aspect it is evident that this includes much of agriculture, forestry, horticulture, pharmacognosy, floriculture and cognate subjects

At the lower end of this great kingdom of plant life we find the beginning of what we know as living

[1] Address delivered at the opening program of the twenty fifth anniversary exercises of the Brooklyn Botanic Garden, May 13, 1935

organisms, those complex molecules that we call protoplasm, that are able under favorable conditions to sustain and reproduce themselves from the inorganic elements of their environment, the so called autotrophic microorganisms These are the simplest types of living organisms Some of them are so small that they are invisible under the highest powers of the microscope Others are more like fungi or algae without chlorophyll, though some of them do contain chromogen materials The energy that they need for their life processes they are able to draw from the inorganic materials of their environment, from combinations of nitrogen phosphorus, sulfur, chlorine, potassium, calcium, magnesium, iron, copper, manganese and possibly a few other elements This ability to extract energy from inorganic compounds, utilizing it for the reduction of carbon dioxide to organic compounds, is limited to a very few species, but they are of very great importance in soil formation and in soil fertility They include such genera as *Nitrosomonas, Nitrosococcus,* which oxidize ammonia to nitrite, *Nitrobacter* which oxidizes nitrite to nitrate, and species of the genus *Thiobacillus,* which oxidize sulfur and its compounds, utilizing also light energy Others oxidize iron and manganous compounds and others oxidize hydrogen Some of these contain pigment and may be algae rather than true bacteria

Then comes the great group of microscopic parasitic and saprophytic *heterotrophic Bacteria* We know now as a result of the facts brought to light by those who study these forms of plant life that they bring about fundamental transformations and changes necessary to the existence of higher forms of life In association with other plants or plant remains some of them oxidize atmospheric nitrogen into nitric acid and ammonia in forms available to higher plants Some of them have formed cooperative or symbiotic relations with higher plants, as for example with Leguminosae, the alfalfas, clovers, peas beans, which are among our most valuable soil building and feed and food crops They prepare the food material for higher plants They separate these materials again when the plant or the animal that feeds on them dies Others have become parasitic, causing disease and destruction to higher plants or animals Crown gall or plant cancer, pear blight and various rots and wilts, some extremely destructive, are examples of plant diseases caused by bacteria Tuberculosis, anthrax, tetanus, typhoid fever, cholera pneumonia are among the well known and destructive animal diseases caused by bacteria

In this same general group of parasitic and saprophytic organisms are the fungi, yeasts, moulds, rusts, smuts, toadstools, mushrooms, bracket fungi, and hosts of others, some helpful and valuable, others harmful and causing destructive diseases of plants and animals This group is especially prolific in species causing plant diseases Some of the most destructive and best known examples are the black rot of grapes, bitter rot of apples, apple scab, peach and plum rot, the fusarium wilts of cotton, flax and cow peas, the root rot of corn and the scab of wheat and barley, the rusts and smuts of wheat and other cereals and a great variety of other plants, the mildew rots of grape, potato and hops, the heart rots of trees and various root rots chestnut blight and Dutch elm disease

Most of these fungi have complicated life histories living in different forms on totally unrelated plants One form, or stage, of the black rust of cereals, for example, lives only on certain species of barberry (*B vulgaris* group), from which it moves again to the cereal host The blister rust of the white pine passes part of its life on gooseberry and currant leaves The unraveling of these life histories is the most effective means to a knowledge of effective control

The black rust of wheat of the bread varieties can be controlled in part by destroying the common barberry (*B vulgaris*) in the regions where these wheats are grown The blister rust of white pine can not be prevented, except by destroying the gooseberries and currants in the vicinity of white pines These are simply two well known examples of hundreds of other similar associations, some with plants and some with insects, highly important to our welfare to understand Dr Geo M Reed, of the Brooklyn Botanic Garden, is doing some outstanding work on smut diseases of cereal grains These diseases are very destructive and difficult to control Dr Reed has discovered the existence of physiological races or varieties of smuts Varieties of the parasite that look exactly alike under the microscope may be quite different in their ability to infect a particular strain or variety of grain These facts must be taken into consideration in breeding for resistance to smut infection The smuts cause enormous losses in a great variety of cereals The work that is being done here by Dr Reed in cooperation with the United States Department of Agriculture is of very great scientific as well as of very great practical value in giving us increased power to protect our most important food crops

The average annual loss to our crop plants caused by diseases alone averages 10 per cent, or more than $500,000,000 a year All our botanical research in this field costs less than one tenth of one per cent of the annual saving from the application of its results A careful estimate made in 1928 covering about 40 years of research by the Bureau of Plant Industry of the U S Department of Agriculture in cooperation with

other agencies in the general field of applied botany showed an annual saving and gain of more than $500 for every dollar expended

Let us move upward now on the ladder of life from the lowest forms of plant life to those organisms that are more commonly known as plants, *viz*, those organisms that are green They differ from the bacteria and fungi in that they are able to live normally only in the light They draw their energy from the sun, utilizing it to combine carbon dioxide with water, forming starch, sugar and cellulose, freeing bound oxygen in the process which adds materially to our slowly waning atmospheric supply They then bring about combinations of sugar and nitrate or ammonia forming albuminoids and proteins, which are the basis of protoplasm, both in plants and animals Plant and animal life, except the small group of bacteria able to obtain their energy from inorganic sources would be impossible without this fixation of carbon and transformation of energy carried on by green plants Some of these green plants are so small that they are invisible to the unaided eye, single cells no larger than some of the bacteria These are the simple algae, furnishing foods for other forms of microscopic aquatic animal life which in turn are the food of forms of increasing size and complexity, and finally for oysters, lobsters, crabs and fish and other forms of aquatic animal life Others are banded together into great masses of surprising beauty, like the sea weeds Others are the grass of the field, which "to day is and to morrow is cast into the oven' or dies down to enrich the soil for the corn and wheat the vine and the fruit tree or the great trees of the forest

Plants are the great soil builders and protectors of soil from wind and water erosion Where we have destroyed vegetation planlessly and thoughtlessly we are rapidly losing our soil by wind erosion in dry periods and by water erosion in wet periods In the last few years the topsoil on millions of acres west of the 100th meridian has been blown away in dust storms Millions of acres have been covered by wind blown sand This is largely the result of overgrazing and consequent destruction of the plant cover or destruction of the plant cover by breaking up the sod to prepare the land for wheat or other crops The danger has been appreciated by botanists and agriculturists for many years But their warnings have not been heeded Experiment stations established in this dryland area two decades ago have studied these problems and have pointed out safe uses for these lands, but lack of general appreciation of the danger has prevented general adoption of the methods recommended The situation is now so serious that the whole nation is awake to it Our botanists, ecologists and agriculturists are striving to find soil binding plants and methods of checking erosion and in a measure repairing the damage Botanical explorers are visiting various parts of the world to find additions to our store of drought resistant and soil binding plants to aid in this recovery program Many valuable wild and cultivated species are being introduced Botanic gardens furnish extremely valuable help in this and other plant introduction work

In the areas formerly forested a similar process of unwise destruction of the forest cover has been going on for many years Land of little or no value for agriculture has been denuded of its trees through destructive lumbering followed by fire The exposed soil has been washed into the streams, choking their channels Heavy rains are followed by floods Navigation and power resources are destroyed The aquatic plants are destroyed followed by the animal life, fish and game when their primary food source is gone The whole balance of nature is thus upset What was once a source of wealth, and under proper use would have continued to be such, is rapidly becoming a barren waste and a source of danger The indiscriminate dumping of sewage and industrial wastes into streams lakes and the ocean is rapidly destroying aquatic vegetation of all types beneficial to aquatic animal life and the source of their food supply Oysters, clams, crabs fish and waterfowl disappear with their food supply The public does not yet understand this danger to our great natural aquatic resources, and destruction still goes on Here is a great field for the botanist and zoologist to do effective research and educational work It is encouraging to note that the Secretary of War has appointed a committee to look into this pollution problem

A program of erosion control has been recently inaugurated in a large way, and reforestation, range control on the public domain and land use programs are now matters of national concern Intelligent plans are being made to correct these maladjustments as rapidly as possible Botanical knowledge and research are the keys to the solution of these great problems In this new era botany in its broad sense will be called upon to play an increasingly important part in the reestablishment of biologically balanced areas The ecologists and physiologists have a large part to play The plant explorers have important contributions to make The phytopathologists must be on the job There is work for the expert systematists, the algologists and bacteriologists, as well as foresters and agronomists In all this work botanic gardens and arboretums will prove to be of increasing value

With careful study and planning we shall be able in many cases to improve on the former natural vegetation In many cases we shall use our rapidly increas-

ing knowledge of genetics to breed and fix better varieties and strains of plants better adapted to special uses —plants that are more resistant to drouth and cold, more firmly and deeply rooted, more resistant to disease and insect pests, and of better or more desirable quality for uses to which they may be put All these things are now being done by botanists Gradually through botanical study we have learned some of the secrets of making new varieties and species and establishing and even patenting some of them

The plant breeder could not exercise this power to produce and establish new varieties with the efficiency now attained had not the student of genetics made available a large fund of information in this special field of research The story is a long one, starting with the discovery of the sexuality of plants by Camerarias in 1691 Probably the most important discovery was that of Gregor Mendel more than a century ago in regard to the law of the distribution of unit characters in the progeny of hybrids With improved technique and equipment it is possible now to connect certain characters of the progeny with the genes (the heredity units) of the chromosome controlling those particular characters It may be possible in the future to more definitely control the combination of different genes to produce the new varieties of plants having the combination of the characters desired This is now accomplished by crossing large numbers of individuals having the unit characters desired, then selecting and recombining until the desired result is obtained By taking advantage of the Mendelian formula the fixed strains of the desired type if produced may be segregated in three generations, provided further crossing is eliminated By using these methods the rust and drouth resistance of macaroni wheats (*Triticum durum*) have been successfully combined with *T vulgare* the ordinary bread wheat At the wheat breeding station at Omsk, Russia, the bread wheats have been successfully crossed with a wild grass *Agropyron elongatum*, transmitting drouth rust and alkali resistance to the progeny Wilt resistance of the citron has been bred into the watermelon The resistance of certain Asiatic chestnuts to chestnut blight has been bred into the American chestnut Almost every variety of cultivated crop has been improved in one or more particulars by plant breeders Some fine work of this kind is in progress here Dr Graves, of the staff of this garden, for several years has been collaborating with the Federal Department of Agriculture in producing hybrids between the American and Japanese and Chinese varieties of chestnuts, with a view to producing a tree which will not only be immune to chestnut blight, which has almost exterminated the American chestnut, but will also be a valuable timber tree The results strongly indicate that this much desired objective will be accomplished Botanic gardens and arboretums are especially valuable as sources of breeding material and as centers where such studies can be carried on They are among the most important sources of living plant material and are invaluable centers of technical and practical information in every phase of botanical study in its broadest sense We need more of them and we should give them better financial support Aside from their generally recognized practical value, they have great civic and educational value especially to the community in which they are located Another line of development is the artificial production of mutation (inheritable variation not the direct result of crossing) by exposing the reproductive cells to x rays and similar types of radiation Profound changes are produced in this way

Dr Gager, the director of the Brooklyn Botanic Garden shortly before coming to Brooklyn conducted extensive pioneer studies on the effect of the rays of radium on the various life processes of plants, and since coming to Brooklyn he has collaborated with Dr Blakeslee, of the Carnegie Institution of Washington, in exposing reproductive cells to radium rays The result of this work was to produce probably for the first time inheritable changes in living organisms by exposing their living cells to penetrating radiation It is epoch making work and is a field worthy of most careful study Then there is the newly discovered mode of germplasmic origin of new characters *aristogenes*, of which at present we have no control [2]

By varying the length of exposure to light and by modifying the wave-lengths of the light used or by increasing or decreasing the intensity of the total light and modifying the periods of exposure we can produce profound changes in the time of flowers and fruiting This method of control has already proved to be of great value in plant breeding in the control of flowering periods and it may have much wider use, especially in plant introduction and adaptation Changes in chemical composition, especially the vitamin content, may be brought about by light control This vitamin content of plant tissue is especially important The vitamins appear to be of the nature of vegetable hormones, certain of them controlling growth in animals, others control lime assimilation, reproduction and resistance to disease This is one of the most productive and active fields of plant physiological, biochemical and biophysical research at the present time It is opening a new field of nutrition and health preservation and control and prevention of some of the most serious diseases of man and other animals, such as tuberculosis, beriberi, scurvy, rickets, xerophthalmia, pellagra, rheumatism and others.

[2] SCIENCE, n. s., 80 2087, 604, December 28, 1934

The ultra-violet rays are principally involved in vitamin formation. These rays are largely eliminated by ordinary glass Leafy field crops, like lettuce, grown under ordinary glass, should therefore receive supplementary ultra violet light treatment if their vitamin content is to be up to normal Special glass transmitting these rays is now available but at considerably increased cost Special ultra violet light radiation equipment is also available

The environmental, nutritional and genetic factors controlling the production in the plant of other valuable organic constituents—gums, oils, fats, alkaloids rubber—are still very imperfectly understood and offer a productive field of great scientific and economic value Here again botanic gardens and arboreta afford the most helpful aids to such investigations Time does not permit multiplication of examples of how botany, a knowledge of plant life, in one way or another enters into almost every aspect of our welfare The time allotted might easily be consumed in the more detailed presentation of some narrow field, but I have selected the more general and less technical presentation so that those of you who are not botanists may get the broader perspective of the relation of botany to human welfare

In closing this presentation I wish to give you an illustration of the importance of intensive study of problems that may appear at first sight to have no possible value to humanity Botanists as well as other scientists, are frequently criticized for devoting too much time and money to what the critic considers to be quite useless and worthless but which may later prove of very great value There are numberless examples I have time to call your attention to but one in which the Bureau of Plant Industry of the U S Department of Agriculture found uses for an apparently unimportant discovery made by Karl Wilhelm von Nageli, a brilliant Swiss botanist Von Nägeli, desiring to study under the microscope the activities of living plant cells, selected for the purpose what is popularly known as "frog spittle" or "green slime," a fresh water alga belonging to the genus *Spirogyra* This alga grows in ponds and slow streams and looks to the naked eye like fine, long, green silk threads The microscope shows that the thread is made up of large cylindrical cells attached end to end having spiral bands of chlorophyll The protoplasm and nucleus show clearly It is thus easy to see the living cell in operation This, of course, was the reason for selecting this plant for study It might not have appealed very strongly to the visiting committee of farmers and business men or the president of the university had they happened in at that time They probably would have been more disgusted than was Nägeli himself when he could not get the alga to grow in his carefully prepared synthetic solutions, containing everything needed by the alga in just the right proportions Day after day he tested and retested to find the reason why the *Spirogyra* died in his aquarium but would live in the water brought in from the pond containing the same nutrient salts In his synthetic solutions made up from distilled water and from tap water, the *Spirogyra* after a few hours turned brown, broke up into short pieces and in twelve to twenty four hours was dead To make a long story short he finally traced the cause of death to minute traces of copper taken up from the bronze faucet in his laboratory as the water passed through it The amount of copper was so small that it could not be detected by any chemical method known But the chlorophyll band in the *Spirogyra* cell reacted to one part of copper in 50 million parts of water It thus proved to be the most sensitive test known for copper He described his researches and published them in a little pamphlet which remained untranslated and almost forgotten for more than half a century

The next chapter in the story opens with a letter received by the Department of Agriculture from a cress grower, who complained that he and other growers were being put out of business by some disease attacking the cress As this was quite an important industry in which many millions of dollars were invested, we sent Dr George T Moore to investigate He found that the trouble was caused by *Spirogyra* smothering the cress He thought right away of the work of Nageli and made arrangements to add copper, 1 part to 50 million, to the water in some of the beds It worked exactly as Nageli has described The Spirogyra was destroyed without injury to the cress The cost was negligible This led to a further study in the use of copper in destroying algae of various kinds in water reservoirs Certain forms of alga growth make water almost impossible to use at certain times of the year due to bad taste and odor imparted to it Methods were worked out making it possible by treatment with copper to remove any of these contaminating species at small expense The methods developed have now become standard sanitary engineering practice

The next development grew out of the observation that in these copper treated waters certain species of bacteria were greatly reduced in numbers These belonged to the *colon* group Tests were therefore made on typhoid, para-colon, Asiatic cholera and related species It was found that these could be destroyed in a few hours by the introduction of small amounts of copper sulfate or metallic copper without the slightest danger to those using the water Certain types of fish, however, were killed This led also to the testing of chlorine for these types of bacteria

Chlorine was found to be effective in destroying bacterial pollution without injury to fish but did not destroy algae Both methods have now become standard practice in sanitary engineering

The next development grew out of the observation that mosquito larvae were killed by these traces of copper, 1 part to 10 million Colonel Gorgas requested that we send one of our men with him to clean up the zone in the Isthmus of Panama through which we were to dig the Panama Canal The late Karl Kellerman was assigned to the job and used the copper treatment exclusively in destroying algae and mosquito larvae when it was not practicable to use oil

The use of copper in water supplies was followed by a study of copper in animal nutrition The results of that study show that it is absolutely essential along with iron for haemoglobin formation in the red blooded animals Its absence in the diet brings on secondary anemias that result in death if copper is not supplied A trace of copper also proved to be essential in the growth of plants What the next chapters will be I do not know But I do know that Nageli s work on "frog spittle" paved the way for work of very great value to humanity many years after he had passed away

We must encourage and support research in all fields It is the only key to progress Botanical research has made it possible to produce food sufficient for earth's teeming millions if they will stop fighting and intelligently use the knowledge already gained

In conclusion, I am sorry that the last annual report of the Brooklyn Botanic Garden did not come to my attention before I prepared my address for this evening A discussion of that report would be a forceful presentation of botany and human affairs The Brooklyn Garden is outstanding among the gardens of this country in its public relations contacts and in its cooperation with civic agencies of city, state and nation, in educating the public to appreciate the value, to the community, of botany in its many aspects and relations Director Gager has been selected as chairman of the subcommittee having in charge this aspect of the plans for the National Botanic Garden at Washington

THE ABSORPTION OF SOUND IN GASES[1]

By Professor VERN O KNUDSEN
DEAN OF GRADUATE STUDY THE UNIVERSITY OF CALIFORNIA AT LOS ANGELES

THE experiments I shall here describe, which began with studies in architectural acoustics, have led to the discovery of important, although peculiar and unsuspected, laws concerning the propagation of sound in the atmosphere and other gases[2] The results obtained also conform remarkably well with predictions of modern theories of the dispersion and absorption of sound in gases In this latter connection the results exhibit a new technique for investigating the nature of energy transfers during molecular collisions

The classical theories of Stokes and Kirchhoff on the absorption of sound in gases were based upon the effects of viscosity and heat conductivity, and until recently it has been assumed generally that these effects accounted for the observed attenuation of sound in the air and other gases These classical theories, which require the attenuation to increase with the square of the frequency, explain, qualitatively at least, why, when listening to distant echoes of speech, we hear only the low frequency vowels and do not hear the high frequency consonants, which are absorbed in the air before reaching our ears However, certain acoustical phenomena which nearly every one must have observed in his early youth, are not even qualitatively explained by these classical theories Thus, the sound of an approaching train or a wagon coming over a cobblestone road can be heard more distinctly and at a greater distance when a storm is gathering (usually characterized by a drop in temperature and an increase in humidity) than when the air is warm and relatively dry, and the sounds of ordinary speech can be heard at distances of more than a mile on cold, dry days Reliable observations of such Arctic explorers as Stefansson indicate that at $-80°$ F conversations as far away as five or six miles have been heard and understood, and that other sounds, as the barking of dogs or the chopping of wood, have been heard at distances as great as fifteen miles These long distance transmissions of sound through the atmosphere are usually explained by assuming that the temperature of the air increases from the ground upward—often referred to as an inverted temperature gradient—which would cause the sound waves to be refracted downward and thus spread out essentially in two dimensions over a wide horizontal zone, whereas, under the more common condition of

[1] At the request of the editor of SCIENCE this non technical article has been prepared by the author of the paper presented at Pittsburgh to which was awarded the prize for a notable contribution presented at the annual meeting of the American Association for the Advancement of Science —ED

[2] The experiments are described more completely in papers in the April (1935) issue of the *Journal of the Acoustical Society of America* and in previous issues of this journal

a decreasing temperature from the ground upward—referred to as a normal temperature gradient—the sound waves are refracted upward and thus are not heard at great distances by observers on the ground Although temperature refraction is an important factor in explaining the propagation of sound in the atmosphere, it is not sufficient to account, for example, for the observed differences of sound transmission in temperate and frigid zones, since the air may be characterized by an inverted temperature gradient in both zones, and, as we shall see the acoustical "transparency" of the air is greatly dependent upon both temperature and humidity

The modern theory of the absorption of sound in gases began with a paper by Jeans in 1904, and has been developed into a useful form by the contributions of Einstein in 1920, Hertzfeld and Rice in 1928 and Kneser and others since 1931 The work of Kneser,[3] the theoretical part of which was modeled after the treatise by Einstein, not only led to convenient equations for calculating the velocity and absorption of sound in gases but was followed by an experimental study on the velocity of sound in CO which gave results in good agreement with his dispersion formula

In the simplest form of this modern theory, such as is here sufficient to account for the observed absorption in air and oxygen, it is assumed that there are only normal or non vibrating molecules, and one kind of vibrating molecules having a characteristic frequency and a characteristic life time' (average duration of a quantum of vibration) The theory shows that the absorption coefficient per wave length is

$$\mu = 2\pi \left[\frac{RC}{C_\infty(C_\infty + R)} \quad \frac{\omega k_0}{k_0^2 + \omega^2}\right] \qquad (1)$$

where R is the gas constant C_∞ is the heat capacity of the gas for sound of infinite frequency, C is the internal heat capacity, ω is 2π times the sound frequency and k_{10} is a reaction constant which gives the number of transitions from the excited to the normal state per molecule per second The maximal value of the absorption coefficient μ_m occurs when $k_{10} = \omega$, so that

$$\mu_m = \pi \left[\frac{RC}{C_\infty(C_\infty + R)}\right] \qquad (2)$$

From (2) it is seen that the maximal absorption, which occurs when $\omega = k_{10}$, is a constant which, for a certain gas, depends only on C_i and C_∞, and that the maximal absorption coefficient per unit length $m_m = \mu_m/\lambda$ (where λ is the wave length) is proportional directly to the frequency Further, it is evident from (1) that in order to determine the reaction constant k_{10} either for a pure gas or a gas mixture it is necessary only to determine the frequency at which the absorption is a maximum

Before the above theory had been fully developed, the author's attempt to calibrate a new reverberation chamber revealed that the absorption in air at ordinary temperatures and humidities was very much greater than the value predicted by classical theory, and depended upon humidity and temperature in a characteristic manner These results were obtained by measuring the rate of decay of sound in two similarly shaped rooms, having the same boundary material (painted concrete) and containing air of the same temperature and humidity, but having different mean free paths (the average distance the sound waves travel between successive reflections)

The success of the initial two room experiment suggested the desirability of using smaller chambers in which the temperature and humidity of the air could be more easily controlled and in which other gases could be investigated Accordingly, a six foot cubical chamber and a two foot cubical chamber were constructed from one fourth inch steel boiler plate, strengthened with angle iron, spaced two feet on centers The chambers are equipped with rotating paddles which keep the sound in a diffuse state The source of tone is a high frequency loud speaker actuated by a pure sine wave alternating current from an audio frequency oscillator The rate of decay of sound in the chamber is measured by a specially designed reverberation meter consisting of an electrodynamic microphone, amplifier, attenuator, rotating contacts and neon lamp indicator[4]

Figure 1 shows the results of a series of measure-

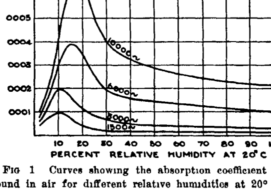

FIG 1 Curves showing the absorption coefficient of sound in air for different relative humidities at 20° C Note that for each sound frequency there is a certain humidity at which the absorption is a maximum

[3] H O Kneser, *Ann d Phys* 11 761–801, 1931, *Jour Acous Soc*, 5 122–126, 1933

[4] The apparatus is described in an article by the author in the *Jour Acous Soc*, 5 112–121, 1933

ments on the absorption of audible sound in air for different relative humidities at a temperature of 20° C, for frequencies of 1,500, 3,000, 6,000 and 10,000 cycles It will be noticed that for each frequency there is a certain humidity at which the absorption is a maximum Further, the magnitudes of these maxima are proportional directly to the frequency and *not* to the square of the frequency, as is required by classical theory Also, the magnitude of the absorption at any frequency or humidity is greatly in excess of the amount predicted by the classical theory—the observed absorption is of the order of 10 to 100 times greater than the classical absorption For example, at a relative humidity of 18 per cent and for a frequency of 10,000 cycles, the absorption (or attenuation) coefficient is 0 00065 per cm, or 0 020 per ft Hence, such a plane wave would have its intensity reduced to $\frac{1}{e}$ of its initial intensity after traveling a distance $\left(\frac{1}{0\ 020}\right)$, or 50 feet This is equivalent to a rate of decay of 96 db per sec, or 450 db per mile—a rate of decay which is in excess of the most desirable rate of decay for good acoustics in auditoriums, and which is so high as to exclude the possibility of using tones above or even near, this frequency for long distance signaling in the air [5]

Having determined the nature and magnitude of the very high absorption of sound in air containing different amounts of water vapor, the investigation was continued in the direction of ascertaining whether the oxygen, nitrogen or some other component of the air were responsible for the anomalous absorption Accordingly, measurements were made in oxygen plus water vapor and in nitrogen plus water vapor In these experiments we obtained the interesting result that the values of the maximal absorption (μ_m) in oxygen plus water vapor were almost exactly five times greater than the corresponding maxima for air plus water vapor, and in the case of nitrogen plus water vapor we found that there was no appreciable absorption in excess of classical absorption, and no dependence of absorption upon the concentration of water vapor

These findings suggested that the absorption was almost, if not entirely, attributable to the oxygen in the air, and in fact, Dr H O Kneser, who was then at the University of California, showed that the results were in good agreement with Eqs (1) and (2) provided the absorption resulted entirely from energy transfers between oxygen molecules and provided further that the reaction constant k_{10} were a quadratic function of the concentration of the water vapor

[5] These problems are discussed at greater length in the article referred to in footnote 4

Water vapor is the only gas we have worked with which, when added to oxygen, obeys this quadratic relation, for all other impurities the reaction constant is a linear function of the concentration

The above measurements in air and in oxygen were made at a temperature of 20° C At a temperature of 55° C, the absorption in air and oxygen, containing small amounts of water vapor, reached maxima which were approximately twice as large as those obtained at 20° C This result is in good agreement with the predicted values based on Eqs (1) and (2)

On the other hand, measurements in air at −15° C indicated that there was practically no absorption at this temperature—certainly not much more than the classical absorption—and there was no measurable variation of absorption with humidity

These experiments at different temperatures and humidities explain, in part at least, why sounds are transmitted over such great distances in the cold, dry air of the Arctic, and why similar sounds are stifled in the hot desert air, which so often has just the required humidity to give maximal absorption All problems associated with the propagation of sound in the atmosphere must reckon with this anomalous absorption I shall mention only two typical problems (1) for a given temperature and relative humidity of the air there is an optimal frequency for long range sound signaling, usually not more than 2,000 cycles per second, and (2) in the reproducing of sound in large theaters, and especially in the out-of doors, selective amplification, in amount and character dependent upon temperature and humidity, should be given to the high frequencies

The good agreement between the observed and calculated values of the absorption of sound in oxygen plus water vapor indicated that similar absorption measurements in pure or mixed gases should provide an effective means for investigating energy transitions during molecular collisions Accordingly, Kneser and the author undertook a series of experiments on the absorption of sound in oxygen containing known amounts of gaseous impurities [6]

The results of these experiments show that the reaction constant k_{10} for O_2 is strongly influenced both by the kind and amount of gaseous impurities, a conclusion which for other gases had been previously reached from dispersion measurements at supersonic frequencies by Richards and Reid and by Eucken and Becker

Kneser has calculated the collision frequencies and the probabilities of transitions between excited and normal oxygen molecules for the different gaseous im-

[6] Kneser and Knudsen, *Ann d Phys*, 21: 682–696, 1935

purities in oxygen with which we have worked[6] From these calculations it is found that when an excited oxygen molecule collides with an alcohol molecule the probability is slightly better than 1 in 1,000 that the vibrating oxygen molecule will lose its vibrational energy This probability of transition is of the order of 5,000 times the probability of transition in collisions between two oxygen molecules This probability of transition decreases progressively, and in the order named, for impurities of ammonia, benzene, water vapor, acetylene, hydrogen sulfide, car bon tetrachloride, carbon monoxide, hydrogen, carbon dioxide, nitrogen, helium and oxygen A collision between two oxygen molecules is thus seen to be the least probable type of collision for producing transi tions between normal and excited oxygen molecules It also appears that hydrogen molecules are more effective than helium molecules for producing transi tions

As yet insufficient data are available to offer a complete explanation of the collision process How ever, a number of tentative assumptions are sug gested by the data obtained to date[6]

(1) The simple impulse theory of the transfer of energy at collision is inadequate, since hydrogen, for example, is more effective than the heavier helium

(2) If an oxygen molecule collides with a molecule having a dipole moment, the collision is more likely to disturb the nuclear vibrations of the oxygen mole-cule than is the case in a collision with a molecule which has no dipole moment Thus, our data indicate that carbon monoxide is more effective than the simi lar nitrogen molecule

(3) Our results would seem to support the sugges-tion of Eucken and Becker that a strong disturbance should be expected if the collision partners have a high chemical affinity

In conclusion, the experiments described in this paper indicate that the measurement of sound ab sorption in gases provides a new approach to a num-ber of important problems related to molecular col lisions In addition, the absorption measurements in air are of general interest to the most casual observer They not only clarify a large number of curious problems associated with the influence of the weather on the acoustics of the atmosphere, but they have an immediate and practical application in architectural acoustics and sound signaling

OBITUARY

HUGO DE VRIES

1848–1935

ON May 21, in the little Dutch village of Lunteren, a kindly old man in his eighty seventh year died, and the news was cabled to all parts of the civilized world The passing of Hugo de Vries brings to a close a life rich in achievement

De Vries was a botanist, but his early work on turgor in plants influenced the development of chemi cal theory By means of the plasmolytic method he determined the relative influence of molecular solu tions of various salts and organic compounds upon osmotic pressure of the cell sap and expressed these differences in terms of his isotonic coefficients It was upon these studies that Van't Hoff and Arrhenius based their laws of disassociation in dilute solutions which form one of the fundamental concepts of physi cal chemistry

De Vries is most widely known, however, for his influence on biological thought In 1889 he published his theory of intracellular pangenesis, in which, on the basis of extensive observations, he argued that heredi tary particles corresponding to the different adult characters must be present in all cells of the organ-ism This is an early statement of our modern con cept of the gene In his foreword to Gager's trans lation of "Intracellular Pangenesis," Strasburger writes as follows "By creative imagination Hugo de Vries predicted much in his book that gained a mate-rial basis only through the histological research of the following decades he predicted phenomena which were to furnish the basis for our conceptions of fertilization and heredity but which have become actually known to us only through later works on the most intimate processes of nuclear division" His powers of prophetic imagination are also shown in an address delivered at the opening of the Station for Experimental Evolution in 1904 He urged that at-tempts be made to alter the hereditary particles in germ cells by application of external stimuli He pointed out that x rays and radium have been found capable of bringing about important changes in liv-ing organisms "If the same holds good for our dor mant representatives in the egg we may hope some day to apply the physiological activity of the rays of Röntgen and Curie to experimental morphology" It was nearly a quarter of a century before this hope of de Vries was realized

De Vries was the outstanding figure in the biologi cal world in the early part of this century when genetics was being born and new and revolutionary ideas were appearing in rapid succession More than any other man he helped to lead biologists from the speculative age of Darwin into an age of experimen-

tation He was the first of the three in 1900 who announced the discovery of the laws of Mendel from their own independent investigations His name is more closely associated, however, with the mutation theory which he announced in 1901 In this, from study of a wealth of material, he was able to distinguish between fluctuating variations caused by the environment and changes due to the sudden origin of a new hereditary unit which he called a mutation

In the evening primrose (*Oenothera Lamarckiana*) upon which the mutation theory was largely based, de Vries thought he had found a species in a state of rapid mutation to "elementary species" The literature on the genetics of this form from the pen of de Vries and his followers has reached a large volume, but it is now agreed that most of its frequent mutations are not due to new hereditary units (or genes, as we now call them) but rather to alterations in genic balance brought about by changes in amounts of relatively large blocks of chromosomal material This change in interpretation does not detract from the value of the mutation theory which was a tremendous stimulus to research and which has become firmly established from facts in a wide range of forms among both animals and plants

The mutation theory alone appears to be an inadequate explanation of the origin of species, but if the study of evolution ever becomes thoroughly experimental, as there are indications may be the case, a large share in the credit will be due to Hugo de Vries

De Vries was born in Haarlem on February 16, 1848 His doctorate was received from the University of Leiden in 1870 After study in German universities, he was called in 1877 to a lectureship in the University of Amsterdam, where later he was advanced to the professorship of plant physiology, a position which he retained until he retired in 1918 at the age of 70 Upon this occasion his papers were reprinted in a series of seven volumes entitled "Opera e Periodicis Collata" His later years were spent in Lunteren, Holland, where he had a small greenhouse and garden in which he continued his experiments on the evening primroses almost to the end He three times visited this country in 1904 when he helped to dedicate the Station for Experimental Evolution of the Carnegie Institution of Washington and gave a course of lectures at the University of California, in 1906 again to give lectures at the University of California and in 1912, when he came to give an address at the opening of the Rice Institute

Among published photographs of de Vries and accounts of his life may be mentioned those by Lehman,[1] Almquist,[2] Shull[3] and the writer[4]

[1] E Lehman, "Hugo de Vries, 6 Vorträge zur feier Seines 80 Geburtstages" Tubinger Naturw Abhandl 62 pgs F Enke Stuttgart, 1929

Few scientists have influenced so profoundly the theory and experimental practice in their fields of research as did de Vries He brought to bear upon his investigations a combination of mental qualities which are rarely developed to the same degree in a single individual He was a keen observer, a patient accumulator of data, an untiring and meticulous experimenter, skilful in interpretation of evidence and yet able to relate his findings to broad problems of fundamental importance He was a man of theory and vision as well as a gatherer of details in laboratory and garden, a pioneer and prophet The name of Hugo de Vries will forever remain an inspiration to all biologists

ALBERT F BLAKESLEE

WILLIAM PARKER CUTTER

WILLIAM PARKER CUTTER, librarian of the Bermuda Biological Station for Research, died at the Massachusetts General Hospital on May 20, 1935, and was buried in Mt Pleasant Cemetery, Arlington, on May 22

Mr Cutter had been connected with several scientific institutions and important libraries in the United States before assuming charge of the library of the Bermuda Biological Station He was born at Washington, D C, on December 19, 1867, graduated at Cornell University in 1888, was chemist at the Agricultural Experiment Station, Logan, Utah, from 1890–1893, librarian of the Department of Agriculture, Washington, from 1893–1900, chief of the order department of the Library of Congress, 1901–1904, librarian of the Forbes Library Northampton, Massachusetts, 1904–11, librarian of the Engineering Societies, New York, 1911–17, manager of the book department of the Chemical Catalog Company, 1918–20, librarian, Research Library, National Aniline and Chemical Company, 1921–22, director of the information department, Arthur D Little, Inc, 1922–27, assistant librarian, Baker Library, Harvard University, 1928–32, librarian, Bermuda Biological Station, 1933–35 He was a member of the American Library Association and secretary of the joint committee on Classification of Technical Literature, 1915–17 He was the author of "Rare Books and Their Values," 1903, and also of various articles on library topics

In his last years Mr Cutter's health was frail, and he sought relief from the extremes of the New England climate in the more equable climate of Bermuda, where

[2] Ernst Almquist, "Grosse Biologen Eine Geschichte der Biologie und ihrer Erforscher" 143 pgs, J F Lehmann, Munchen, 1931

[3] G H Shull, *Journal of Heredity*, 24 3–6, 1933

[4] A F Blakeslee, *Scientific Monthly*, 36 279–280, 1933 This article has been drawn upon in preparation of the present note

he was appointed librarian of the new Bermuda Biological Station for Research There he reorganized and in large part catalogued the books, journals and pamphlets already on hand, as well as about 600 newly acquired volumes, and some 20 journals and serial publications obtained by gift or purchase He also superintended repairs to many old volumes that had suffered injury, and he devised ingenious means of protecting books from mould and the ravages of insects, which are such a serious menace to libraries in warm countries

His most important service at the Bermuda Station consisted in planning and supervising the conversion of an unused power house, near the main building into a well lighted, commodious and fireproof library building and in equipping this and transferring to it the publications from the crowded quarters in the main building On March 30 last the new library was formally opened by His Excellency, the Governor of Bermuda, in the presence of a distinguished company of scientists, officers and trustees of the station and other invited guests, and on that occasion tribute was paid to Mr Cutter by the director of the station Dr J F G Wheeler, the senior trustee in Bermuda, Honorable F Goodwin Gosling and by Mr Paul Vanderbilt, librarian of the Pennsylvania Museum of Art a former pupil and associate of Mr Cutter, who called him "one of the greatest librarians of the United States" Mr Cutter was present and took part in the formal opening of the library and it is a source of gratification to his many friends that he lived to see the consummation of his plans for the new library and to receive the tributes which were paid to him on that occasion

Edwin G Conklin

MEMORIALS

The trustees of Columbia University have voted to name the Astronomical Observatory the Rutherfurd Observatory, in honor and in memory of Lewis M Rutherfurd, who was the first astronomer to introduce photographic methods of precision in the field of astronomy

A tablet in memory of Dr William H Welch was unveiled on June 5 at the Happy Hills Convalescent Home for Children near Bellevue, Md Dr Welch was one of the founders of the home and its first and only president

The state of New York, Schenectady County and Union College joined on May 29 in a memorial celebration for Dr Franklin B Hough, "Father of American Forestry," in simple ceremonies in the college building, where he first worked with "botanical and mineralogical specimens," for which he gave up the practice of medicine to crusade for the conservation of natural resources in New York and in the nation An oil portrait of Dr Hough, who died in 1885, was presented to Union College by J P Apperson, chairman of Governor Herbert H Lehman's committee for celebrating New York's fifty years of conservation in Schenectady County Dr Willis R Whitney, of the General Electric Company, and a trustee of Union College, was chairman of the exercises Lithgow Osborne, state conservation commissioner, Mr Apperson and Dr Dixon Ryan Fox, president of Union College and a member of Governor Lehman's general celebration committee, spoke

Marie Curie Avenue New York City, which parallels the East River from Sixty third to Eightieth Street, was officially dedicated on June 9 by Mayor F H La Guardia at the close of ceremonies attended by representatives of the Polish and French Consulates More than 3 000 persons were present The occasion marked the thirty seventh anniversary of the discovery of radium

A banquet in support of a British memorial to Madame Curie was held recently in London The purpose was to raise $250 000 for the endowment and extension of the Marie Curie Hospital of London Sir Neville Chamberlain, who took the chair, said that he had been asked to do so because of his long association with the ministry of health Sir William Bragg was the principal speaker

RECENT DEATHS

Adam M Miller dean of the Long Island College of Medicine died suddenly at his home in Mountain Lakes, N J on May 28, 1935 He had been dean for fifteen years and professor of anatomy since 1914 During his tenure of administrative office he played a most important part in the reorganization of the college as it merged from the Medical College of the Long Island College Hospital into its present status He was born in Homewood, Pa, on April 2, 1879 He graduated from Princeton, A B, 1901, M A 1902, and remained there as a graduate fellow in biology under Edwin G Conklin until 1903 He then joined the staff of George S Huntington at the College of Physicians and Surgeons, Columbia University, where he continued his studies in embryology It was there that he, in collaboration with Frederick R Bailey, published the "Text Book on Embryology" From 1903 to 1912 he was instructor in the department of histology and embryology at the College of Physicians and Surgeons, and from 1912 to 1914 was assistant professor of anatomy He went to Brooklyn in 1914 as professor of anatomy at the Long Island College Hospital

DR. BENJAMIN S WARREN, from 1922 to 1934 medical director of the U S Public Health Service, died on May 20, at the age of sixty three years

JOSEPH THOMAS CUNNINGHAM, marine zoologist and biologist of the London Hospital Medical College, has died at the age of seventy six years

PROFESSOR GAETANO FICHERA, who was the director of the Milan Institute for Cancer Research, died on May 21 He was fifty five years of age

SCIENTIFIC EVENTS

THE MEDICAL CURRICULUM IN GREAT BRITAIN

THERE was published on May 17 the report of the conference of representatives, nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England and the Society of Apothecaries of London, on the medical curriculum

The members of the conference were Lord Dawson of Penn (chairman), Professor Sir E Farquhar Buzzard (chairman of the Executive Committee), Professor G E Gask (vice chairman of the Executive Committee), Professor Sir Walter Langdon Brown, Dr A F Clark Kennedy, Sir Raymond H P Crawfurd, Professor Winifred Cullis, Professor H R Dean, Professor C A Lovatt Evans, E L Pearce Gould, Dr A M H Gray, Professor W W Jameson, T Bramley Layton, Dr M H MacKeith, Professor Sir Ewen Maclean, W H Ogilvie, Sir Holburt Waring and Professor W Wright, with G W Rossetti as secretary

The following are among the recommendations of the conference

That the minimum length of the medical curriculum be not extended beyond the present period of five years

Medical studies proper—*i e* anatomy and physiology—should not be begun before the age of 18

In view of the very considerable difficulties experienced by schools in teaching candidates for the requirements of the different syllabuses of the several examinations for 1st M B or basic sciences, the syllabuses in chemistry physics and biology in the examinations for 1st M B or basic sciences of the different licensing bodies should be brought more into line one with another

To ensure, during the period subsequent to passing matriculation, the continuance at schools of the general education of intending medical students, the licensing bodies should consider the possibility of allowing and encouraging exemption from the 1st M B examination by means of a higher school certificate examination conducted by any recognized examining body, in which, in addition to the three principal scientific subjects a subsidiary non scientific subject be taken

During the first two years (six terms) of medical studies the work of the student should be arranged by a board of teachers representing anatomy, physiology, chemistry, biochemistry, pharmacology and pathology

During the first four terms of medical studies the student should continue the study of chemistry, carry out work in the dissecting room and department of anatomy, and, in the second term, begin the study of elementary physiology and biochemistry

During the fifth and sixth terms of medical studies, while continuing the study of anatomy and physiology, the student should be introduced to the principles of general pathology, immunology and bacteriology by a pathologist

The teaching of organic, physical and colloidal chemistry should be determined by conference between the teachers of physiology, biochemistry and chemistry, due weight being given to the opinions of the teachers of physiology on the special needs of students of medicine

The teacher of anatomy should be given access to hospital material for teaching applied anatomy, with or without the assistance of a clinician attached to his department

During the second year of medical studies the teacher of physiology, being provided, if necessary, for this purpose with a clinical assistant, should give demonstrations in applied physiology and familiarize the student with the use of the stethoscope, the ophthalmoscope, the laryngoscope and the otoscope

During the second year of medical studies the teaching of pharmacology, which shall include toxicology, should be arranged in close cooperation with the teachers of physiology

During the second year of medical studies the student should attend a short course of lectures in elementary medical psychology

THE PRESIDENT'S STATEMENT TO THE COUNCIL OF THE AMERICAN CHEMICAL SOCIETY

AT the meeting of the council of the American Chemical Society in New York City, on April 24, Professor Roger Adams gave the following summary of the work of the society to the one hundred and sixty six councilors present at the meeting

Since the beginning of 1934, the American Chemical Society has operated under a new plan of membership fees In brief, individuals joining the society pay $9 for the privilege of membership and for the *News Edition* A fixed additional sum is charged for each of the journals and members may select on this basis one or more of those desired This procedure was introduced to accommodate those men who must consider their expenses carefully, and those who for one reason or another do not require all the society's pub-

lications. The detailed plans so carefully and skilfully developed by a committee of the society and adopted by the council have proved to be a very successful experiment It has, Dr Adams believes, operated to the satisfaction of practically all the membership and to the advantage of the American Chemical Society

In 1932 and 1933 the society's income was insufficient to meet even the reduced budgets of those years It is encouraging, therefore, that in 1934 the funds received were adequate, not only to handle all the financial obligations, but also to offset partially the rather substantial deficit of the previous year The advertising revenue also improved As a result of the somewhat larger income, the directors felt justified in increasing the publication appropriation in the 1935 budget so that the *Journal of the American Chemical Society* and *Industrial and Engineering Chemistry* might provide more effectively for the printing of material submitted by the members and that *Chemical Abstracts,* which had been required to contract below the desirable minimum, might expand slightly its presentation of the chemical literature of the world

Because of the difficult years through which the society has just passed, a few comparative figures on the membership and subscriptions are pertinent To day the total membership is 17 003 On April 1 of this year, there were over 1 800 $9 members representing about a 25 per cent increase in this group over last year The maximum number of resignations came at the beginning of 1933 but each year since then the number has materially decreased, at that time, also the number of new members and reinstatements was at a minimum but has increased regularly during the intervening period

As of April 1, 1935, the *Journal of the American Chemical Society* and *Chemical Abstracts* have each received subscriptions amounting to over 300 more than last year and *Industrial and Engineering Chemistry* to over 800 more The total subscriptions of all paid members and non members to the three publications at present is over 9,100 for the *Journal of the American Chemical Society,* over 11,500 for *Chemical Abstracts* and over 14,700 for *Industrial and Engineering Chemistry* The *News Edition* enjoys the largest circulation of any magazine going to chemists—18 616 All indications point to a healthy condition of the society, all curves point upward

Of the various committees of the society appointed last year, one of special interest because of its particular objectives may be mentioned It has been actively engaged in studying the requirements of courses in education for chemists before they are eligible for teaching positions in high schools

During 1934 the unemployment problem has received special attention In addition to the free advertisement in the employment information pages of the *News Edition,* the activities of several of the local sections and the aid which is given through the secretary s office in placing before employers the names of unemployed, a committee of the society with an appropriation for necessary expenses has been attempting to determine the actual unemployment conditions among chemists and to point out how the society might cooperate to alleviate them

The problem is a complicated one and extends beyond the attempt to find vacancies for those out of work It involves a consideration of the training of the individuals as demanded by industry and the personal qualifications of those unemployed It is recognized by all that the American Chemical Society cannot directly create positions for chemists It can and has devoted untiring effort to make the nation chemically conscious and thus indirectly to stimulate the industries to an appreciation of what contributions the chemist may make in a wide variety of fields of endeavor Cooperation of the many efficient local agencies and of the national society in devising methods for aiding the unemployed should unquestionably lead to improved conditions

INSTITUTIONS SELECTED FOR WORK BY FELLOWS OF THE NATIONAL RESEARCH COUNCIL

THE National Research Council has issued a bulletin giving the results of an inquiry into the institutions selected by research fellows in physical science at which to carry on their work These results, with special reference to the situation at Princeton University are summarized in the *Alumni Weekly,* in part, as follows

National Research Council grants are given only to holders of the Ph D degree Certain men divide their time among two or more universities and in the following tables each institution has been credited as if the individual had spent his entire time there Fellows in mathematics are accredited jointly to Princeton University and to the Institute for Advanced Study, the mathematics divisions of which cooperate in many phases of graduate work

Chicago continues in first place in the matter of training men who are to be awarded National Research Council fellowships but Princeton is close behind. For the three branches of science, future winners of fellowships have received Ph D degrees from the following universities, among others

PLACE OF GRADUATE TRAINING
Past and Active Fellows

Chicago	45	Wisconsin	23
Princeton	43	Yale	22
California	37	Columbia	16
Harvard	35	Cornell	16
C I T	31	M I T	14
Hopkins	31	Michigan	14

Princeton has undisputed first place on a list of the institutions at which the fellowship holders elected to study These are the figures for certain of the leading institutions in the three sciences

Place Selected for Advanced Research
Past and Active Fellows

Princeton	104	Hopkins	17
Harvard	85	Yale	15
C I T	79	Wisconsin	12
Chicago	52	Cornell	9
California	40	Columbia	8
M I T	33	Michigan	8

The two tables above can be combined to give an approximate statement of the universities standing There are rarely duplications between the two lists

Combined Table
Past and Active Fellows

Princeton	147	M I T	47
Harvard	1[illegible]0	Yale	37
C I T	110	Wisconsin	35
Chicago	97	Cornell	25
California	77	Columbia	24
Hopkins	48	Michigan	22

Counting only the fellows active at the present time, Princeton also enjoys first position indicating that the record of the past is being maintained

Combined Table
Active Fellows

Princeton	18	Wisconsin	5
Harvard	12	Chicago	4
California	11	N Y U	4
C I T	11	Columbia	3
M I T	11	Cornell	3
Hopkins	8	Brown	2
Illinois	6	Iowa	2
		Yale	2

California has the best record in physics among this year's fellows, three of its doctors holding fellowships at other universities, and four men from elsewhere having elected to study at Berkeley Second place in physics this year goes to California Institute of Technology, and third to Massachusetts Institute of Technology Princeton, New York University and Wisconsin are tied for fourth

The Massachusetts Institute of Technology is first in chemistry and is followed by California Institute of Technology, Harvard, California, Princeton and Wisconsin

In mathematics Princeton is followed by Brown, Harvard, Hopkins and Chicago

ENGINEERING IN THE SUMMER SESSION OF COLUMBIA UNIVERSITY

During the thirty sixth Summer Session of Columbia University, which begins on July 8 and continues until August 16, instruction will be given in chemical, civil, drafting, electrical and household engineering

Professor Arthur W Hixson will be in charge of work in chemical engineering With Professor Lincoln T Work he will supervise a chemical engineering laboratory in which a thorough experimental study will be made of the basic operations employed in chemical manufacturing plants Professor William D Turner will conduct a course in the Chandler Laboratories on the application of chemistry in industry Industries producing chemicals, using chemical methods or involving chemical control of process will be studied The course is also designed for teachers of general chemistry in high schools and colleges who wish an up to date knowledge of practical chemistry as a means of bringing greater human interest into their teaching Research work will be carried on in the laboratories by advanced students under the direction of Professors Hixon, Work and Turner

Camp Columbia, at Lakeside, Conn, will be the headquarters for students of civil engineering, who will be under the direction of Professor James K Finch A lake adjoins the camp cabins, which are situated in the hills on a ten acre tract

Work in electrical engineering will be carried on by Professor F W Hehre, while the engineering drafting work will be under the supervision of Professor C H Schumann, Jr, who will have charge of engineering drafting Descriptive geometry, statistical drafting and mechanical drafting will also be studied in this division

Household engineering, dealing with the fundamental principles of mechanics, heat and electricity and their applications to the home, as well as a course on simple tests of household appliances, will be directed by Professor Carleton J Lynde, of the department of physics

A special series of lectures by Dean Joseph W Barker, of the Columbia School of Engineering, and others will deal with "Science and Mathematics in Engineering" The lectures will be designed to assist teachers in their work of counseling with high school students concerning vocational careers Specialists will represent each of the major fields of engineering

SCIENTIFIC NOTES AND NEWS

The degree of doctor of science was conferred on June 4 at the commencement exercises of Columbia University on William Slocum Barstow, electrical engineer, and on Harvey Fletcher, electrical engineer and director of acoustical research in the Bell Telephone Laboratories.

AT the one hundred and sixty ninth commencement of Rutgers University Admiral Richard Evelyn Byrd was granted the honorary degree of doctor of laws in recognition of his "valor in exploration"

AT the commencement of the University of Pittsburgh on June 5, the honorary degree of doctor of science was conferred on William A Hamor, assistant director of the Mellon Institute of Industrial Research

STEVENS INSTITUTE OF TECHNOLOGY at the sixty third annual commencement exercises conferred the degree of doctor of engineering on John Castlereagh Parker, president of the Brooklyn Edison Company formerly professor of electrical engineering at the University of Michigan, on Adolf Meyer, director of the Steam Turbine Department of Brown, Boveri and Company, Switzerland, on Robert C Stanley president of the International Nickel Company, and on Walter Kidde, president of Walter Kidde Constructors

DR. JOHN M T FINNEY, professor emeritus of surgery at the Johns Hopkins Medical School, received the honorary degree of doctor of laws at the commencement exercises of the Tulane University of Louisiana

AT the one hundred and thirteenth annual commencement of the Philadelphia College of Pharmacy and Science, held on June 5, honorary degrees were conferred on Dr William A Pearson, dean of the Hahnemann Medical College of Philadelphia, on Eli Lilly, president of Eli Lilly and Company, and on John M Woodside, member of the Pennsylvania Board of Pharmacy and long a retail pharmacist in Philadelphia

PROFESSOR WILLIAM G OWENS, of the department of chemistry of Bucknell University, who retires after serving for fifty five years, was the guest of honor at a formal dinner on June 7, at which President Homer P Rainey presided

A TESTIMONIAL dinner to Dr J G Lipman, dean of the College of Agriculture of Rutgers University and director of the New Jersey Agricultural Experiment Station, was held in New Brunswick, N J, on June 5, by the members of the department of soils and crops and the editorial staff of *Soil Science* in commemoration of his twenty years as editor in chief of this journal, which he founded in 1915 The first number of Volume 40, which is dedicated to Dr Lipman, includes articles concerned with his achievements in soil science and his influence upon research in this field Papers were contributed by Sir John Russell, Rothamsted Experimental Station, England, Dr S A Waksman and Professor A W Blair, New Jersey Agricultural Experiment Station, Dr R V Allison, Bureau of Chemistry and Soils, U S Department of Agriculture, Dr Oswald Schreiner, Division of Soil Fertility Investigations, U S Department of Agriculture, Dr P E Brown, Iowa State College, Dr S Winogradsky, Pasteur Institute, France, Dr A A J De'Sigmond, Budapest, Hungary, Dr Hendrik Lundegardh, Experimentalfaltet, Stockholm, Sweden, and Dr W P Kelley, University of California

To commemorate the eightieth birthday of Dr Alfred Cort Haddon fellow of Christ's College, Cambridge, and sometime university reader in ethnology, a number of friends under the guidance of Louis Clarke, curator of the Museum of Archeology and Ethnology, paid a tribute to the great services rendered by Dr Haddon in the study of ethnology at a special gathering recently held in the museum at which a large cabinet to contain hundreds of indexed and catalogued photographs which Dr Haddon had collected during the past forty years was presented to him Professor Seligman, a former pupil and a colleague of Dr Haddon in the Torres Straits Expedition, made the presentation, and in his reply Dr Haddon announced his intention of handing over the photographs to the Board of Archeology and Ethnology of the university

DR HERBERT F PRYTHERCH, director of the U S Fisheries Biological Station at Beaufort, N C, was recently elected president of the National Shellfisheries Association and chairman of the State Board of Directors of the North Carolina Fishermans Cooperative Association

OFFICERS of the British Institute of Physics have been elected as follows *President* Professor A Fowler, *Vice president* Dr G W C Kaye, *Honorary Treasurer,* Major C E S Phillips *Honorary Secretary,* Professor J A Crowther *New Members of the Board,* A P M Fleming and Dr B L Worsnop

DR CHARLES SIDNEY BURWELL dean-elect and research professor of clinical medicine in the Harvard Medical School, formerly professor of medicine at Vanderbilt University, has been appointed to the staff of the Peter Bent Brigham Hospital, Boston, as physician, where he will continue clinical investigations of heart disease

DR ROY R GRINKER, associate professor of neurology in the Graduate School of Medicine, Division of Biological Sciences of the University of Chicago, will be in charge of the new department of psychiatry, the establishment of which was recently made possible by a grant of $168,000 from the Rockefeller Foundation Dr Grinker will return to the university on July 1, after two years abroad spent in research under a fellowship from the foundation.

DR. NICHOLSON J EASTMAN, acting professor of

gynecology and obstetrics at Peiping Union Medical College, China, has been appointed professor of obstetrics at the Johns Hopkins Medical School and obstetrician in-chief at the Johns Hopkins Hospital Dr Eastman will succeed Dr J Whitridge Williams, who died in 1931

DR R E COKER has been appointed chairman of the Division of the Natural Sciences in the senior college of the University of North Carolina Under a new plan taking effect next session a senior college is formed with four divisions The several divisions are concerned with programs of study, but not with administrative matters which remain in the hands of the deans

COLONEL JAMES HIRAM GRAHAM, Louisville, consulting engineer, who graduated from the University of Kentucky in 1900, has been appointed dean of the College of Engineering

PROFESSOR J A S RITSON has been appointed to the chair of mining at the University of London, tenable at the Imperial College, Royal School of Mines, from January 1, 1936 Since 1923 he has been professor of mining at the University of Leeds

THE court of the University of Glasgow has appointed Dr T Alty, research professor of physics in the University of Saskatchewan, to the Cargill chair of applied physics vacant by the death of Professor J G Gray

DR. J A MURRAY will retire as director of the British Imperial Cancer Research Fund at the end of the year He will be succeeded by Dr William E Gye, of the National Institute for Medical Research, Hampstead

THE trustees of the Louis D Beaumont Trust have allotted $1,000 to the research department of the Barnard Free Skin and Cancer Hospital of St Louis, Mo, of which Dr M G Seelig is director A similar allotment was made last year

GRANTS awarded by the Committee on Scientific Research of the American Medical Association include a grant to Dr Harold Jeghers for an investigation of vitamin A deficiencies in certain diseases—Dr Jeghers will conduct his studies at the Boston City Hospital on the Fifth Medical Service under the auspices of the Department of Medicine of Boston University, to Dr P L Heitmeyer, Portland, Ore, for research on intra uterine ovarian implants—his work on the problem was begun at the University of Pennsylvania Graduate School of Medicine and is to be continued at the University of Oregon Medical School, and to Dr Avron Barnett, assistant in medicine at the Brooklyn Jewish Hospital, for researches concerning the mechanisms involved in impedance angle measurements The work is to be carried out in the laboratory of pharmacology of Professor George B Wallace, at the New York University College of Medicine

DR. WINFRED OVERHOLSER, commissioner of mental diseases of Massachusetts, has appointed a "Departmental Research Committee" the purpose of which is stimulation and coordination of research activities in the State Hospitals of the Commonwealth The members of the committee are Drs Abraham Myerson, *chairman*, Douglas A Thom, R G Hoskins, Neil A Dayton and Harry D Solomon The Rockefeller Foundation is supporting research programs in the Worcester State Hospital and the Boston State Hospital as well as an elaborate statistical project of the department at Boston

CARNEGIE CORPORATION grants to the value of £400 each for the year 1935–36 have been awarded by the executive council of the Universities Bureau of the British Empire to Professor T J Haarhoff, of the University of the Witwatersrand, Professor T H Laby, of the University of Melbourne, and Professor Meghnad Saha, of Allahabad University

DR. WILLIAM BEEBE and four associates, comprising the annual tropical research expedition of the New York Zoological Society, arrived at Hamilton, Bermuda, on June 2

DR JOHN FRANKLIN DANIEL professor of zoology in the University of California, plans a nine months' world tour of study and investigation during which he hopes to obtain more information on amphibian embryos

DR. ROSS A GORTNER professor of agricultural chemistry at the University of Minnesota and chief of the division at the State Agricultural Experiment Station, will be the George F Baker non resident lecturer at Cornell University in the first term of the coming academic year The general subject of the lectures will be "Colloids with Reference to Biochemical Problems"

THE graduation address at the Buckingham School, Cambridge, Mass, was given on June 7 by Dr Harlow Shapley, director of the Harvard College Observatory

DR. GANO DUNN, who is president of the board of trustees of Cooper Union, New York City, gave the commencement address at the union on June 6

THE three hundredth anniversary of the National Museum of Natural History, Paris, will be celebrated from June 24 to 29

IN Paris, from September 15 to 23, will take place the first International Congress for the Unity of Science, the general aim of which is to consider all ques-

tions relevant to scientific enterprise as a whole A preliminary congress concerned with laying plans for the first International Congress was held in Prague, in September, 1934 The report of the preliminary congress is available in the journal *Erkenntnis,* or in book form from Felix Meiner (Leipzig) At that time a temporary committee of organization was formed with the following membership Carnap (Prague), Frank (Prague), Jørgensen (Copenhagen), Lukasiewicz (Warsaw), Morris (Chicago), Neurath (The Hague) Reichenbach (Istanbul), Rougier (Cairo), Schlick (Vienna) A permanent committee is in process of formation, and acceptances to membership have been received from Bridgman, Cartan, Enriquez, Fréchet Paul Gautier, Hadamard, Pierre Janet, Kotarbinski Lashley, C I Lewis, C Nicolle When completed the committee will be representative of all the main fields of science Correspondence may be addressed to the secretary, Dr Otto Neurath, Mundaneum Institute 267 Obrechtstraat, The Hague, Holland

A meeting and dinner of the Institute of Management, a research group of the American Management Association, was held in New York City on May 24 The morning session was devoted to a discussion of wage incentives methods Dr Richard Stephen Uhrbrock, head of the research department, Industrial Relations Division, the Procter and Gamble Company presented the paper—"A Psychologist Looks at Wage Incentives Methods" Dr Arthur W Kornhauser, associate professor of business psychology School of Business, University of Chicago, in collaboration with Paul Lazarsfeld, of the Psychological Institute, University of Vienna, gave the afternoon paper, which was on "The Techniques of Market Research from the Standpoint of a Psychologist" There was a dinner meeting in the evening, when the Henry Laurence Gantt Medal "for outstanding and creative work in the field of industrial relations" was presented to Arthur H Young Following the presentation Sumner H Slichter, professor of business economics at the Graduate School of Business Administration of Harvard University, gave an address on "Current Labor Trends"

The trustees of the Rockefeller Foundation have appropriated £60,000 towards the cost of the building and equipment of the proposed Institute for the Teaching and Study of Neurology at the National Hospital for Nervous Diseases, London, and a further sum of £60,000 towards the endowment for teaching and research which will have their center in the new building

The Regius professor of medicine at the University of Oxford, Sir E Farquhar Buzzard, has introduced a statute to create an Institute for Medical Research He pointed out that this was the latest development of a five years' scheme which had its origin in the purchase by Lord Nuffield from the Radcliffe Trustees of the observatory ground and buildings for the joint benefit of the Radcliffe Infirmary and the Oxford Medical School The share of the university consisted of the buildings and a small part of the land The institute will be partly devoted to therapeutic research and partly to x ray cinematography It will enable bachelors to do in Oxford the necessary work for the doctor's degree and may lay the foundation for a complete Medical School It is hoped to establish the institute this year with Professor Gunn as its director and Dr Franklin in charge of the x ray cinematography

The new buildings of the British Postgraduate School at Hammersmith, associated with the University of London, were opened by the King and the Queen of England on May 13 The school is designed to provide post graduate medical education for British doctors and for medical men from the Continent and abroad The dean of the school, Colonel Alfred H Procter, explained in a statement that for a long while there had been a great need in England for a center where post graduates might revise and improve their medical knowledge The school would also be a center where medical men from the Colonies could learn what was being done in London It was decided in 1921 that a school should be established for qualified doctors and that the best solution to the problem was a separate hospital A capital grant of £250 000 was proposed, but the financial crisis of 1931 made revision essential and eventually the government decided to make a grant of £100,000 The London County Council agreed to spend an equal amount The new buildings—three blocks—were completed in January Already post graduate students from England the Colonies and abroad are studying there, and four two week refresher courses are beginning this month A staff of professors and readers are at work

Nature reports that the German government has issued an announcement referring to the work of the German bird migration research stations in Helgoland and at Rossitten where rings are attached every year to the feet of more than 160,000 migratory birds The rings are inscribed with identification numbers and with the address of one or other of the stations The stations are anxious to receive reports of the finding of these birds in any part of the world with the view of gaining further information as to bird migration and other phenomena of bird life They will gratefully acknowledge all such reports, and are prepared to furnish in reply information not only as regards the bird in question, but also as regards their work generally Reports will be sufficiently addressed if directed to Vogelwarte Helgoland, Germany, or Vogelwarte Rossitten, Germany

DISCUSSION

JUVENILE CHARACTERS OF ROYAL PALMS

FOUR species of royal palms are now represented in southern Florida and may be distinguished in their juvenile stages by leaf characters that are not apparent in the adult palms Flowers and fruits are not produced until the palms are from 25 to 30 feet tall, when the leaves and inflorescences are out of reach for comparison Little dependence can be placed upon the sizes and shapes of the trunks, which vary with conditions of growth from slender and tapering to robust and ventricose Most of the adult palms in Florida are of the native species, *Roystonea floridana*, which is being used extensively for street and ornamental planting, but other species are being introduced, so that means of distinguishing them are of increasing interest

The Barbadian royal palm *Roystonea oleracea* is characterized by the pinnae of the juvenile leaves being wide and pendent, in contrast with narrow spreading or erect pinnae in the other species at the corresponding stages of growth, when the plants are from 3 to 6 feet high In the younger stages of *oleracea* the leaf sheath, petiole and rachis are tinged with a deep red, the color being nearly the same as that of the small appressed scales scattered over the surface, while in the other species the surfaces are green, though the scales are reddish or brownish

The leaves of the Cuban royal palm *Roystonea regia* have close set narrow erect pinnae, in contrast with spreading or horizontal pinnae in other species at the same stage of growth Also the reddish brown scales of the leaf sheaths continue in the Cuban species to be very abundant after the trunk forming stage of the plant has been reached, and on many individuals even to the fruiting stage, while the other species have fewer and smaller scales, so that the leaf sheaths usually appear entirely clean by the time that the trunks are a few feet high

The royal palm of Puerto Rico, *Roystonea borinquena*, and the native royal palm of Florida, *Roystonea floridana*, are alike in the narrow spreading pinnae of their juvenile leaves, but the Puerto Rican species has a lighter green color and the surface scales reach a larger size, so that the rachis and petiole have a notably freckled appearance, also the midrib of the pinna has a readily perceptible row of scales, while in the Florida species the scales are relatively minute and inconspicuous, the difference being obvious when the pinnae are about half an inch wide

The pinnae of *Roystonea floridana* later are much wider and rather close set and drooping, in notable contrast with narrower and more erect pinnae in *Roystonea regia*, the Cuban species Even in the adult stage a greater tendency to erect pinnae may be seen in the Cuban palm, though all the species share the adult character of having the pinnae inserted at different angles to the rachis Another adult difference is that the petioles of the Florida palms tend to be more rigid, so that the leaves do not droop around the leaf-sheath bundle as in the Cuban species, but form a broad umbrella crown, in this respect having a greater resemblance to the Barbadian species, *Roystonea oleracea*

O F COOK

BUREAU OF PLANT INDUSTRY

SYNCHRONOUS FIREFLY FLASHING

IN his recent note on synchronous flashing of fireflies experimentally produced,[1] Mr John Bonner Buck regards his experiments with *Photinus pyralis* as indicating that "the whole process depends on the fact that all the [sedentary] females reply to each of the flashes of the male at the same definite [time] interval," thus gradually causing all the males approaching them on the wing to flash in unison From the wording of the last two paragraphs of his note I infer that Mr Buck interprets his observations on this one insect as offering a possible solution to the problem of synchronous flashing of fireflies in general A tropical species of *Photinus*, however, a medium-sized, dark colored Jamaican insect identified by Mr H S Barber as probably *P maritimus* E Olivier, behaves so differently from *P pyralis* as to convince me that there must be several causes of synchronous flashing and that the habit therefore needs to be separately studied and explained in each species that exhibits it

On a broad open 'common" near Mandeville, Jamaica, I found *Photinus maritimus* abundant during the latter part of February and the early part of March, 1931 I was told that simultaneous flashing was not unusual, but until March 8 I failed to see it On that date, between 10 and 10 30 P M, and on subsequent nights, I saw constellation like groups of simultaneously flashing insects forming and disintegrating at different points among the large and active firefly population then on the wing Sometimes it was possible to see as many as three such groups, each flashing like a constellation of from 20 to 40 stars The flashes were single, of short duration, their apparent brightness at distances of from 50 to 75 yards intermediate between the luminosity of the north star

[1] SCIENCE, 81 339–340, April 5, 1935

and the brighter "pointers" of the dipper The groups did not flash simultaneously with each other, but their rate, like that of the independent individuals, was very uniform—20 or 21 flashes to the minute The groups would remain clearly defined for two or three minutes, each one drifting slowly and horizontally in its own direction at a height varying from 10 to 25 feet above the ground They would then disintegrate, their members gradually "falling out of step" with each other Not all the fireflies of this species in sight flashed with the groups—some were always showing their lights independently—but the great majority of those in a given area would temporarily band together

At Pepper, in the Santa Cruz Valley, St Elizabeth on the evening of March 21, 1931 I saw two individuals, apparently of this same species, flying straight ahead across a common at a distance of about 20 feet from each other and 6 feet above the ground While I watched them they flashed in perfect unison 14 times at intervals of about 3 seconds They then disappeared behind some shrubbery I did not measure the distance traversed in this way, but according to my recollection it could not have been much less than 100 yards

Though I have no suggestion to offer regarding the cause of either of these types of simultaneous flashing I can not believe that they are to be explained as responses to females in the grass Superficially, at least, they present an analogy with the simultaneous movements of birds in a flock or of fishes in a school

GERRIT S MILLER, JR

U S NATIONAL MUSEUM

SCIENTIFIC MEN AND THE NEWSPAPERS

MORE important than any of the achievements of science are the philosophical implications of its discoveries—the need for leadership in thinking leadership in the social and economic applications of the discoveries In this leadership scientists are not prominent Their failure to guide the public in adjusting the problems of plenty which the scientists have created may account largely for our economic and social crisis This failure is due largely to the fact that the scientists have been keeping out of the newspapers, out of the place where the public can get acquainted with them, out of the place where the masses make up their minds what kind of leadership to follow

The failure is mostly due to a mechanical maladjustment, to the fact that the scientists do not speak the language of the newspapers, that *is*, of the national forum That language requires emotional appeal For we are interested mostly only in those things which stir our emotions We are likely to act only when our emotions are aroused

The leaders of national thought take this emotional factor into account If scientists did likewise, the public would listen to their message It is because they have not done so that we see such an amazing situation as the attempts to solve unemployment without applying the first principle of science, which is to measure the precise dimensions of a problem Because this principle is not understood, no one has taken an exact census of the unemployed

The same lack is apparent in proposals to establish social security, such as old age pensions and unemployment insurance The lack rises from the fact that the people as a whole have no adequate realization of the nature of the scientific approach

They lack this realization because the scientists have not been telling in the newspapers the story of the frequently dramatic results of using the seemingly prosaic scientific approach Much can be said on both sides as to why the scientists have kept out of newspapers But I do not think there is any question about the harm done by the long years of scientific aloofness

Honesty is the great need in guiding a baffled nation I know of no place where all the principles of honesty, intellectual and moral, are so rigidly and openly spread as in the publications which scientists write for each other These models the public almost never sees The scientific riddles which are solved through this kind of honesty the public hears of only infrequently Unless the public is to remain ignorant, and do so to its great harm, the place to tell about these scientific achievements and their implications is in the daily newspapers

HOWARD W BLAKESLEE,
Science Editor

THE ASSOCIATED PRESS
NEW YORK

BIOLOGICAL ABSTRACTS

WE believe that there are many zoologists who, like the writer, unconnected with *Biological Abstracts*, have heard with dismay of the reported decision of the Rockefeller Foundation to discontinue its support of that journal Through a period of more than eight years we have become accustomed not only to lean heavily upon the *Abstracts* for information in our own fields of research, but also to use it for the revision and strengthening of our lecture notes in fields more remote In the preparation of the latter we have become acquainted with many books and articles of which we would otherwise have remained totally ignorant The titles of many biological publications are woefully inadequate in giving a true idea of their contents, and he who depends upon titles misses many sources of pertinent knowledge The reading of the

best abstract, to be sure, falls short of the gain acquired by reading the article or book abstracted, but an abstract is better than complete ignorance of the publication concerned. Time in which to read all the originals is lacking with most teachers, who strive also to investigate. The cessation of the *Abstracts* would, therefore, mean loss to institutions and to their staffs in the value of both instruction given and research accomplished. We believe that the use of the *Abstracts* has brought home to us a realization that each volume, with all the advantages just hinted at, is really of much greater value to each of us, as individual teachers and investigators, than the nine dollars we have been paying for it each year. From the combined teacher-investigator standpoint, we, therefore, should look on the abandonment of the *Abstracts* as a distinctly backward step in biology. The wider view and the coordination of the various fields of biology which the *Abstracts* has made possible are indispensable. We trust that every effort will be made to secure adequate support for its continuance. We suggest that those who share our thoughts will, each, as far as his individual means allow, establish his own higher rate of subscription, thus showing, at the same time, his appreciation of the benefits which the *Abstracts* confers upon him. The *Abstracts* exists primarily for biologists, and it is the biologists who must largely determine whether it is to be continued or not.

PHILIP P. CALVERT

UNIVERSITY OF PENNSYLVANIA

REPORTS

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT its May, 1935, meeting, the Committee on Grants-in-Aid of the National Research Council made seventy awards as follows:

Physical Sciences: Sebastian Albrecht, research associate, Dudley Observatory, "stellar wave lengths and standard radial velocities"; J. A. Bearden, associate professor of physics, Johns Hopkins University, "a repetition of the Millikan oil drop experiment and a redetermination of the electronic charge"; Lee A. Du Bridge, professor of physics, University of Rochester, "the photoelectric effect in the extreme ultra-violet"; Joseph Kaplan, assistant professor of physics, University of California at Los Angeles, 'interpretation of the Aurora spectrum"; Gleason W. Kenrick, visiting professor of physics, University of Puerto Rico, "radio transmission with particular reference to phenomena peculiar to tropical latitudes"; M. Stanley Livingston, instructor in physics, Cornell University, "nuclear investigations"; J. Rud Nielsen, professor of theoretical physics, University of Oklahoma, "Raman spectra of simple polyatomic molecules"; T. Smith Taylor, professor of physics, Washington and Jefferson College, "development of a standard method for the measurement of the power factor of insulating materials over a frequency range of one megacycle to one hundred megacycles"; Samuel R. Williams, professor of physics, Amherst College, "inter-relations of magnetism and mechanical hardness"; Richard S. Zug, assistant professor of mathematics and astronomy, Drake University, "galactic star clusters."

Chemistry: Richard McL. Badger, assistant professor of chemistry, California Institute of Technology, "the spectra of the simpler polyatomic molecules in the photographic infrared"; James A. Beattie, associate professor of physico-chemical research, Massachusetts Institute of Technology, "relation of the International Temperature Scale to the absolute scale in the range from the freezing point of water to the boiling point of sulphur"; A. Witt Hutchison, assistant professor of chemistry, Pennsylvania State College, "measurement of heat capacities at temperatures attainable with liquid helium"; H. I. Schlesinger, professor of chemistry, and W. C. Johnson, associate professor of chemistry, University of Chicago, jointly, "the hydrogen compounds of boron, silicon and arsenic, and their derivatives"; Nelson W. Taylor, professor of ceramics, Pennsylvania State College, "activation energies in solid phase reactions involving the various polymorphic forms of silica"; Arthur A. Vernon, instructor in physical chemistry, Rhode Island State College, "solubility of electrolytes in non-aqueous solvents"; Roger J. Williams, professor of chemistry, Oregon State College, "the chemical isolation and study of pantothenic acid."

Geology and Geography: Charles Deiss, associate professor of geology, University of Montana, "stratigraphic and paleontologic studies of the Cambrian formations of Montana and Wyoming"; Donald McCoy Fraser, assistant professor of geology, Lehigh University, "petrogenesis of the crystalline rocks in eastern Pennsylvania"; Elbridge C. Jacobs, professor of geology, University of Vermont, "installation of a seismograph for the completion of the seismographic station at the University of Vermont"; K. C. McMurry, professor of geography, University of Michigan, "development of methods for utilizing aerial photography in land inventory and classification"; Oscar B. Muench, professor of chemistry and physics, New Mexico Normal University, "determination of the age of samples of monazite and thucholite from Glorieta, New Mexico"; F. J. Pettijohn, assistant pro-

fessor of geology, University of Chicago, "analysis and correlation of areal mapping in the Lake Superior pre-Cambrian province", Gordon Rittenhouse, research assistant in geology, University of Minnesota, "geology of a portion of the Savant Lake area in northwestern Ontario", Harold W Scott, instructor in geology, Montana School of Mines, "the micro fauna of the Carboniferous of Montana", W H Twenhofel, professor of geology, and R R Shrock, assistant professor of geology, University of Wisconsin, jointly, "field and laboratory studies of the Silurian of Newfoundland"

Medical Sciences M Bodansky, professor of pathological chemistry, University of Texas Medical School, "the relation of the thyroid and adrenals to the composition and metabolism of cardiac and skeletal muscle", S J Crowe, adjunct professor of laryngology and otology, Johns Hopkins University School of Medicine, "the rôle of the several parts of the middle and inner ear in hearing", George M Curtis, professor of surgical research, Ohio State University Medical School, "daily loss of iodine due to toxic goiter", Harry H Donnally, professor of pediatrics, George Washington University School of Medicine, "the use of culture-grown vaccinia virus in vaccinating newly born infants", J A E Eyster, professor of physiology, University of Wisconsin, "action potentials in heart and skeletal muscle", Louis F Fieser, associate professor of chemistry, Harvard University, "carcinogenic hydrocarbons and their derivatives", E M K Geiling, associate professor of pharmacology and experimental therapeutics, Johns Hopkins University Medical School, "histological and pharmacological study of the glands and other parts of whales", Edward L. Howes, research assistant in surgery, Yale University School of Medicine, "wound healing strength", William G Lennox, instructor in neurology, Harvard University Medical School, "the electrical activity of the brain as related to clinical neurology", Valy Menkin, instructor in pathology, Harvard University Medical School, "tuberculosis and inflammation in relation to bacterial invasiveness", C Phillip Miller, associate professor of medicine, University of Chicago Medical School, "the immunological properties and toxicity of various chemically isolated fractions of the meningococcus cell", Mont R Reid, professor of surgery, University of Cincinnati College of Medicine, "therapeutics of arterial disease", B T Simms and J N Shaw, professors of veterinary medicine, Oregon State College, jointly, "lungworm infestation in sheep and goats", Robb S Spray, professor of bacteriology and public hygiene, West Virginia University Medical School, "taxonomic study of the sporulating anaerobes"; Charles W Turner, associate professor of dairy husbandry, University of Missouri, "the physiology of the hypophysis in relation to lactation", William F Windle, associate professor of anatomy, Northwestern University Medical School, "development of behavior in the embryo correlated with development of intrinsic structure of the nervous system"; J M Wolfe, assistant professor of anatomy, Vanderbilt University School of Medicine, "morphologic studies on the relation of the anterior pituitary to the reproductive system", Isolde T Zeckwer, associate in pathology, University of Pennsylvania School of Medicine, "morphological and functional studies of the pituitaries of rats following thyroidectomy"

Biological Sciences S Prentiss Baldwin, director of the Baldwin Bird Research Laboratory, Cleveland, "metabolism of bird embryos during incubation", Sherman C Bishop, professor of zoology, University of Rochester, "the salamanders of North America north of Mexico", H O Burdick, associate professor of biology, Alfred College, "the physiology of fallopian tubes and factors controlling the passage of ova through these tracts", Charles E Burt, professor of biology, Southwestern College, "phylogenetic study of the North American lizards", J F Gates Clarke, instructor in zoology, State College of Washington, "revision of the North American moths of the Genera *Agonopteryx* and *Depressaria*", Harry F Clements, associate professor of botany, State College of Washington, "the freezing resistance in the needles of *Pinus ponderosa* and *Pseudotsuga taxifolia*", Elizabeth Fekete and C V Green, research associates, Roscoe B Jackson Memorial Laboratory, jointly, "the effect of the removal of the mammary glands on the incidence of tumors in a 'high tumor' strain of mice", William R Horsfall, professor of biology, Agricultural and Mechanical College, Arkansas, "the abundance and distribution of species of mosquitoes in southeastern Arkansas", R R Huestis, professor of zoology, University of Oregon, "the inheritance of brown, silver, and flexed tail in *Peromyscus maniculatus*", F B Hutt, professor of poultry husbandry and animal genetics, Cornell University, "the pathological chemical embryology associated with the occurrence of chondrodystrophy in embryos of the domesticated fowl", Alfred C Kinsey, professor of zoology, Indiana University, "collection and study of Mexican gall wasps and their oak hosts", Leon H Leonian, mycologist, West Virginia Experiment Station, "the isolation and identification of growth and sexuality promoting substances for fungi", C C Little, director of the Roscoe B Jackson Memorial Laboratory, "the transplantation of early unimplanted ova from the fallopian tube of pregnant mice of a high tumor stock to the uterus of pregnant animals from a low tumor stock, and *vice versa*", A B Stout, director of the laboratories, New York Botanical Garden, "seedless-

ness in grapes", Don C Warren, professor of poultry genetics, Kansas State College, 'the phenomenon of ovulation in the domestic hen", Allyn J Waterman, assistant professor of biology, Williams College, "heteroplastic transplantations of rabbit and rat embryos", P W Whiting, guest lecturer in zoology, University of Pennsylvania, "sex determination in the parasitic wasp Habrobracon"

Anthropology and Psychology Fay Cooper Cole, professor of anthropology, University of Chicago, "racial criteria in the study of hair", Ernest R Hilgard, assistant professor of psychology, Stanford University, "quantitative characteristics of the process of acquisition and extinction of conditioned responses in man", William A Hunt, assistant professor of psychology, Connecticut College, "behavioral response to a shot stimulus", Theodore F Karwoski, assistant professor of psychology, Dartmouth College, and Mason Crook, instructor in psychology, University of California at Los Angeles, jointly, "quantitative investigation of the sensitivity of the blind spot for spectral light", Paul Kirchhoff, research associate in anthropology, Columbia University, "native agriculture in South America", Karl F Muenzinger, associate professor of psychology, University of Colorado, "analysis of the function of punishment in learning", Sidney M Newhall, Sterling fellow, Yale University, "imagery in recurrent vision", Cornelius Osgood, assistant professor and curator of anthropology, Yale University, "study of the existing anthropological collections from the Athapaskan Indians of Canada and Alaska which have been deposited in museums of northeastern Europe, especially Russia", Vincenzo Petrullo, field director for South American research, University of Pennsylvania, "ethnological studies of the Yaruro peoples in Venezuela"

There will not be another meeting of the Committee on Grants in Aid this year The next meeting of the committee will be held in March, 1936 Applications to be considered at this meeting must be on file with the Secretary of the Committee, Dr Clarence J West, not later than February 15, 1936

ISAIAH BOWMAN,
Chairman, National Research Council

STATE ACADEMIES

THE OHIO ACADEMY OF SCIENCE

THE forty fifth annual meeting of the Ohio Academy of Science was held on April 19 and 20, 1935, at the Ohio State University, under the presidency of Dr James P Porter, of Ohio University, Athens The attendance was good, some 200 members and a large number of visitors, the sectional programs were rich and varied, and a fine spirit of good fellowship was evident on every hand President Rightmire, of the Ohio State University, in his usual pleasing manner bade the academy welcome to the university and made some very fine remarks on the service of science to humanity The invitation address was given by Mr Julius F Stone, traveler, lecturer, capitalist, on the subject, "The Canons of the Green and Colorado Rivers," illustrated with many beautiful slides The president of the academy, Dr Porter, chose for the subject of his presidential address, "Our Sciences with Man Left in," which he presented in a masterly way to the delight and enrichment of a large, select audience Two other papers of general interest were presented before a general session of the academy, namely, one on "Some Scientific and Technical Problems Met with in Investigating the Explosion of the State Office Building," by Dr James R Withrow, of Ohio State University, and the other on "Bobwhite Song Bird or Game Bird," by Dr S Prentiss Baldwin, of the Baldwin Research Laboratory, Gates Mills, Ohio

Other outstanding features of the meeting were a joint meeting of the section of psychology and the Ohio Association of Consulting Psychologists, and a symposium on chemistry in biology under the joint auspices of the sections of botany and chemistry All told, about 120 papers were presented in the various sectional meetings The exhibits and demonstrations were of unusual interest, notably the *heavy water exhibit,* the spectrographic laboratories, ceramics and metallurgy, all of the department of chemistry of the university, also the earthworm (Nephridia in vitro) by Miss Hope Hibbard, of Oberlin College, and some smaller mammals of Wayne County, Ohio, by Earl Cady, of Wooster College

Some 22 new members were elected, and the following members were advanced to the rank of fellows in the academy Dr Mary Auten, Ashland College, Dr Earl Clark Case, University of Cincinnati, Dr Fred Foreman, Oberlin College, Dr Reuel B Frost, Oberlin College, Dr Amos Henry Hersh, Western Reserve University, Dr Herrick Lee Johnston, Ohio State University, Dr Samuel Charles Kendeigh, Baldwin Bird Research Laboratory, Gates Mills, Ohio, Dr Harvey V Moyer, Ohio State University, Dr Ira Templin Wilson, Heidelberg College

The academy passed the following resolutions regarding the so-called "Pest Hunts" "*Resolved,* That the Ohio Academy of Science urges the State Division of Conservation to initiate a thorough, scientific study of all predatory mammals in Ohio, to determine their distribution, abundance, rate of increase, and food

species eaten at various seasons and in various sections, and their economic relationships in the several parts of the state"

The forty fifth meeting was brought to a close by the election of the following officers for the ensuing year

President, Dr Walter H Bucher, *Vice Presidents—Zoology,* Dr David F Miller, *Botany,* Dr Glenn W Blaydes, *Geology,* Dr Grace Ann Stewart *Medical Sciences,* Dr Charles A Doan, *Psychology,* Dr James R Patrick, *Physics and Astronomy,* Dr Charles W Jarvis, *Geography,* Dr Guy-Harold Smith, *Chemistry* Dr K G Busch, *Secretary,* William H Alexander, *Treasurer,* Dr A E Waller, *Members of the Executive Committee,* Dr James P Porter and Dr Eugene Van Cleef

WILLIAM H ALEXANDER,
Secretary

THE IOWA ACADEMY OF SCIENCE

THE forty ninth annual meeting of the Iowa Academy of Science was held with Grinnell College at Grinnell on April 19 and 20 with 249 members and visitors in registered attendance

The presidential address, "This Changing World," was presented by Professor Edward Bartow, of the department of chemistry of the State University of Iowa Other papers of general interest were "The Neural Basis for a Psychogenetic Theory of Feeling and Emotion," by Professor C A Ruckmick, of the department of psychology of the State University of Iowa, and "Some Factors Affecting the Circulation Time of the Blood of Dogs," by Professor E C McCracken, of the department of physics of Iowa State College The annual academy lecture was presented by Dr Leroy C Stewart, of the Dow Chemical Company, of Midland, Michigan His subject, "The Magic Key," described and illustrated the production of bromine from sea water

The following officers and section chairmen were elected for the forthcoming meeting, which is to be held at Iowa City in April, 1936 *President,* R E Buchanan, Iowa State College, *Vice President,* L P Sherman Grinnell College, *Secretary Treasurer* and *Representative of the American Association for the Advancement of Science,* J C Gilman, Iowa State College, *Editor,* Mrs F W Nichols, Ames, Iowa, *Bacteriology and Botany,* H A Wilson, Coe College, *Chemistry general and physical,* William Oelke, Grinnell College, *Chemistry, organic and biological,* Rachel Edgar, Iowa State College, *Geology,* J E Smith, Iowa State College, *Psychology* A R Lauer, Iowa State College, *Mathematics,* Julia Colpitts, Iowa State College, *Physics* Gerald Fox, Iowa State College, *Zoology,* U A Hauber, St Ambrose College

The academy convened in eight sections for the presentation of 117 papers of special interest The Junior Academy of Science of Iowa met with the academy with an attendance of 150 members aside from the Grinnell High School students Dr R W Getchell, of the Iowa State Teachers College, Dr W F Loehwing, of the State University of Iowa, and Dr E W Lindstrom, of the Iowa State College presented talks on their program

JOSEPH C GILMAN,
Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ILLUMINATOR FOR THE BINOCULAR DISSECTING MICROSCOPE

FOR viewing a transparent object by transmitted light with a binocular dissecting microscope, the ordinary artificial light sources do not easily provide equal illumination to both eyes This difficulty has frequently been of considerable importance in the examination of nematode larvae in uncovered drops of water, but it has been obviated by the use of the illuminator described here The basic principle of this device consists of the use of two equal light sources placed at such a distance apart that the same mirror reflects both beams squarely into the corresponding objectives The particular design used has several additional advantages The entire system is enclosed as a dust-tight unit to improve its efficiency and save cleaning time In spite of the complete enclosure, the exposed surfaces are large enough to dissipate the heat rapidly and at a sufficient distance from the operator to eliminate any discomfort even in the hottest weather The light sources and all reflecting surfaces are entirely removed from the field of vision, an important factor in the reduction of eye strain

The entire unit is mounted in a sheet tin box, 25 by 40 cm and 19 cm high, with a tight fitting slip over cover The box is painted dull black inside and out In the accompanying figure the component parts are shown approximately to scale in positions for a microscope placed with the center of the mirror 10 cm from the window Two sockets with an identical pair of ordinary 25 watt, inside frosted bulbs are mounted in

[1] The studies and observations on which this paper is based were conducted under the auspices of the Department of Public Health of the Egyptian Government and the International Health Division of The Rockefeller Foundation

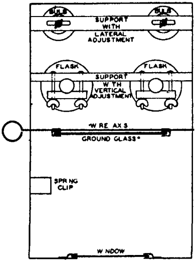

FIG 1 Illuminator for viewing a transparent object by transmitted light with a binocular dissecting microscope

inverted position on a wooden cross piece in such a way as to provide for lateral adjustment In front of the bulbs are two identical 500 cc flasks with alkaline copper sulfate solution They are held in clamps to allow vertical adjustment and are at such a distance apart as to give a correct angle between the beams at the microscope mirror In front of these flasks is a ground glass from a 5 by 7 inch camera This glass is mounted in two pieces of folded tin soldered at the top to a heavy wire running through the two sides of the box and bent at one end to form a handle By rotating this wire, the glass can be raised out of the beam of light into a horizontal position and held there by a spring clip The window in front is 8 cm high and is made of a lantern slide cover or other piece of plane glass slid into a dust tight groove

In assembling the outfit care should be taken with regard to rotation of the bulbs so as to present the flat surface of the filament to the flasks The distances between the bulbs and the flasks must be determined empirically according to the condensing focus of the particular flasks used The other distances can be approximately determined from the distance at which the microscope is to be used, and by means of the clamps, final adjustment can be made to the position of greatest efficiency in actual use

J ALLEN SCOTT
PUBLIC HEALTH LABORATORIES
CAIRO, EGYPT

A MODIFIED BULB PIPETTE

WHILE isolating and transferring Protozoa with a pipette of the medicine dropper type, it occurred to the writer that the manipulation of the pipette might be made much easier if the rubber bulb were moved down over the pipette a short distance This actually proved to be the case when pipettes of this type were made and used for various types of work The writer has found no mention of such a modification in the literature and felt that a sketch and a few explanatory remarks as to the construction of the pipette might be of some value to others

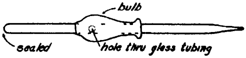

FIG 1

The pipette, shown in the accompanying figure, is not difficult to make One end of a length of glass tubing is first sealed with a flame The region where the bulb is to be placed is then heated with a small flame and a hole is blown through The edges of the hole are then rounded down in the flame A small hole is made in the end of an ordinary rubber pipette bulb, and the bulb is pushed down over the glass tubing It is placed in such a position that the chamber of the bulb will communicate with the lumen of the pipette by means of the hole previously made in the side of the tubing To insure a tight fit, cord or fine wire may be wrapped and drawn up over either end of the bulb The open end of the glass tubing is then heated and drawn out

The size and kind of glass tubing, as well as the length of the pipette, the size of the point, and the place for the bulb will depend upon the preference of the user and the use to which the pipette is to be put

JOHN C LOTZE
OHIO STATE UNIVERSITY

NEW TOWER FILLING MATERIAL

MANY types of tower packing are at present available for such purposes as filling reaction, absorption and distilling towers The author has recently developed a novel form which is free draining and presents a large active surface per unit volume It consists of a maltese cross whose wings have been rotated a sufficient number of degrees (for example, thirty degrees) to impart a rotating motion to the gas passing through the packing This packing may also be made in circular form, with two or more wings, in which case it roughly resembles a propeller Projections or webs may be added for structural strength or to prevent too close contact between adjacent packing units For example, the center may be considerably thickened so that if two units superimpose they will not touch at all points Holes may be introduced for drainage Two or more units may be connected by webs or other

suitable means if so desired. The packing wings may be either plane or curved surfaces, or with suitable projections, and may be made of any of the usual materials of construction, such as stoneware, copper or wire screen.

A. McLaren White
Chapel Hill, N. C.

SPECIAL ARTICLES

POTENTIAL RHYTHMS OF THE CEREBRAL CORTEX DURING SLEEP

Recent interest in brain potentials has induced us to put on record the results of experiments carried out in the Loomis Laboratory, Tuxedo Park, in which a new phenomenon in this fascinating field has appeared most clearly—namely, the very definite occurrence of trains of rhythmic potential changes as a result of sounds heard by a human subject during sleep. Since the work of previous investigators[1] has emphasized that rhythms which spontaneously appear in a person at rest with eyes closed disappear when an object is viewed or the attention concentrated, we believe the definite demonstration of a means of inducing rhythmic brain discharges to be of considerable interest. At the same time the method of continuous study and correlation with other body changes over periods of seven hours, described herein, greatly facilitates interpretation of results where many factors, difficult to control, are undoubtedly involved. Sleep was selected as a condition during which brain activity is at a minimum and physiological conditions most constant.

The records are made on paper wrapped on a horizontal drum 8 feet long and 44 inches in circumference revolving once a minute. Two high speed dynamic siphon recorders describe a pair of spiral lines one fifth inch apart, as they move horizontally parallel to the drum at the rate of one foot per hour. Each heart beat, each respiration, each bed movement and any noises in the bedroom are recorded by one pen (red ink) as characteristic marks, while brain potentials are recorded by the other pen (green ink). In addition three rachet devices sum the heart beats, the respirations and the bed movements each minute, marking the rate per minute on the paper. The drum, driven by a synchronous motor, acts as its own clock, and stimuli may be sent to the sleeper each minute by electric contact on the drum, thereby placing a series of responses near together on the record and allowing easy comparison with the condition where no stimuli are sent in. The amplitude of the brain potentials are ascertained regularly by calibration with sinusoidal potentials of from 2 to 30 per second frequency and from 10 to 50 microvolts amplitude. The siphon recorder records have been checked from time to time by the cathode ray oscillograph.

The finished record is a sheet of paper 44 inches high and 8 feet long with vertical red and green lines, each pair representing a minute of time. Changes in the processes recorded can be seen at a glance. Either the red or the green lines can be rendered invisible by viewing the record through a red or green glass and inspection thereby simplified. The single sheet of paper, even though large, is a great improvement over the use of paper tape, which was abandoned because examination of the one half mile of tape necessary for an eight hour run was too time consuming.

The subject sleeps in a quiet, electrically screened room, containing a very sensitive microphone and a photo electric bed movement recorder. Electrodes for detecting the various physiological processes are attached to the subject and the amplified impulses sent through shielded cables to the control room 66 feet away. Details of the apparatus will be described in a later paper. Facial movements, swallowing, clenching the jaws, etc., give rise to muscle potentials which appear on the record, but which are quite characteristic and easily distinguishable from brain potentials, as are also disturbances due to passive movements of the scalp.

Our investigation of the brain potential rhythms during night sleep (brain electrodes on high forehead and crown of head) has led us to the following conclusions:

(1) They are undoubtedly of cortical origin and distinct from muscle potentials and movement artifacts. Different persons show quite different potential records.

(2) In a night record certain hours of sleep show many "spontaneous" bursts of waves, while other hours show relatively few.

(3) They often appear in trains lasting 5 to 12 seconds, at intervals of ½ to 2 minutes.

(4) The frequency is on the average an irregular 10 per second, but frequently very regular bursts lasting 1 to 1½ seconds of 14 per second frequency appear. The amplitude builds regularly to a maximum and then falls regularly so that we have designated these "spindles" because of their appearance in the record. Shorter spindles or "balls" of ¼–½ second duration occasionally appear. Five other types can also be distinguished.

(5) They are not correlated with heart beat nor necessarily with respiration, but at times a definite characteristic potential change has accompanied each respiration.

(6) Regular snoring does not necessarily initiate

[1] Literature in paper by Adrian and Mathews, *Brain*, 57: 355, 1934, also Jasper and Carmichael, Science, 81: 51, 1935. See H. Berger in *Arch. f. Psychiat.*, 1929–35.

brain rhythms, but an occasional isolated snore may start a train

(7) When asleep sounds of a certain character, such as rustling paper or coughing by a person in the bedroom closing a door some distance from the subject or low conversation, which does not wake the sleeper, will quite regularly initiate a train of waves which may last for from 5 to 8 seconds (frequency 9 to 10/seconds) and then die out Fig 1 A illustrates this effect from the repeated closing of a door at one minute intervals and allows comparison with regions where no sound stimuli were sent in The depth of sleep and the noise level in the room determine whether this sound response will appear One deep sleeper gave no response on closing the door but responded regularly on slamming the door

(8) When awake the same sounds that during sleep initiate a train of waves no longer give rise to them Fig 1 B clearly shows this

(9) During sleep trains of waves appear which can not be correlated with any detectable external stimulus, but which may be connected with internal disturbances of unknown origin The cause of these very regular bursts is now under investigation

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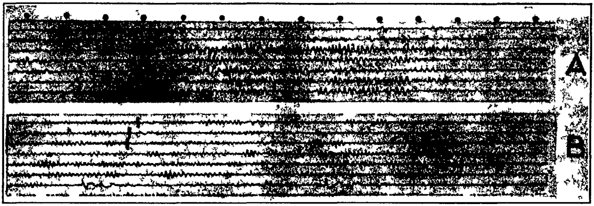

FIG 1 Sections of brain potential records each taken one minute apart Read from left to right At vertical mark sound stimuli sent to subject Note marked trains of brain rhythms in A when subject asleep but none in B when subject awake although stimulated by same sound Time in seconds given by dots at top

THE CENTRIOLE AND ITS ROLE IN MITOSIS AS SEEN IN LIVING CELLS

THE centrioles in the various genera and families of hypermastigote flagellates[1] range in length from 2 or 3 microns to 80 or more and may be seen easily in living organisms, since they are 1 to 3 microns in width The achromatic figure and the manner in which it arises from the centrioles also may be seen very clearly in living cells These protozoa, then, furnish ideal cytological material Unfortunately, however there appears to be a tendency among some cytologists to disregard cytological observations on protozoa, although there is no justification for such a tendency because protozoa are cells, and observations made on them furnish as valuable a basis for generalizations as those made on *Ascaris* eggs, grasshopper testes or other types of classical material Indeed most of the Hypermastigina show much more clearly than any other known cells the centrioles the manner of their duplication the formation of the achromatic figure from them and the rôle of the achromatic figure in chromosome movement Furthermore, observations on living material of these organisms show beyond question that the observations on fixed and stained material deal with realities, not artifacts produced by fixation And the close similarity between the behavior of these hypermastigote centrioles and the centrioles of other cells leaves no room to doubt the general application of the observations on these flagellates to mitosis in both animals and plants

In some genera particularly those with short centrioles as in *Joenia Mesojoenia* and other genera of the Lophomonadidae the achromatic figure arises from the greater portion of the centriole, in other genera, with longer centrioles, it arises only from the distal half or third of the centriole, and in those genera with elongate centrioles, it arises from only a small portion of the centriole, the distal portion In certain genera, the distal portion of the centriole from which the achromatic figure arises is surrounded by a

[1] The names of the 29 genera and 6 families need not be given here, since they are given in a recent publication to which the reader interested in them is referred (*Mem Amer Acad Arts and Sciences*, Vol 17, No 2, 1934)

hyaline centrosome which (in different genera) varies from 2 to 6 microns in diameter, while in other genera no portion of the centriole is surrounded by a centrosome The fibers of the achromatic figure arise from the centriole, not from the centrosome The latter, when present, merely serves a minor function in directing the fibers so as to make the central spindle portion of the achromatic figure less flat or band like This may be seen by comparing the central spindle of *Barbulanympha* with that of *Staurojoenina*

In the interphase in some genera the two centrioles are of equal length, either short or long, while in other genera there is one short and one elongate centriole, the short or daughter centriole elongating in the early prophase In other genera, both centrioles are short in the interphase and elongate in the early prophase After these centrioles have functioned in the production of the achromatic figure, cytoplasmic division occurs and each daughter cell receives one elongate centriole, which soon degenerates except for the proximal portion, so that in the interphase the parent as well as the daughter centriole is short In brief, then, there are (1) short interphase centrioles which function without elongation, (2) short interphase centrioles which elongate in the early prophase, (3) one long and one short centriole in the interphase, the short one elongating in the early prophase, and (4) two elongate centrioles in the interphase The centrioles are continuous from one cell generation to the next, a new one being produced from the proximal portion of an old or persisting centriole during each cell division

In addition to the achromatic figure, all the other extranuclear organelles, such as flagella, parabasals, axostyles etc, arise from the centrioles, so that the centriole is clearly an autonomous organelle, and the dynamic center of the cell since it reproduces itself and all the other organelles except the nucleus (It should be noted, however, that, except in a few genera during the annual encystation generation, the production of flagella and other extranuclear organelles from the centrioles occurs one generation before the production of the achromatic figure See footnote 1)

The achromatic figure which arises from the centrioles is composed of astral rays, some of which join and overlap to form the central spindle, some of which become extranuclear chromosomal fibers, and some of which remain as astral rays throughout mitosis and hence perform no apparent function It is perhaps desirable, however, to avoid the use of the long used term spindle, since it has been used to refer to either the central spindle or the extranuclear chromosomal fibers or both At least, there is less likelihood of confusion if the three parts of the achromatic figure are referred to as astral rays, extranuclear chromosomal fibers and central spindle Of course, it must be realized that the fibers of the central spindle and the extranuclear chromosomal fibers are merely astral rays that are functioning in the process of nuclear division, those of the central spindle serving as a stabilizer which prevents the nucleus from being pulled in two before the proper movement and distribution of the chromosomes, and those that are attached to the chromosomes serving to move the chromosomes to the poles

The formation of the achromatic figure is initiated by the outgrowth of astral rays from each of the interphase centrioles which, in different genera, lie from 5 to 40 microns apart in the cytoplasm The distance from nucleus to centrioles varies in different genera from 2 to 3 microns to 50 or more As the astral rays elongate those arising from one centriole soon meet those arising from the other centriole, when they meet, they join, grow along one another and overlap, thus forming the central spindle, which as it develops depresses the ever intact nuclear membrane and takes up an axial position In the meantime chromosomes have formed and each chromosome is anchored to the nuclear membrane by an intranuclear chromosomal fiber which varies considerably in length in different genera and which should probably be considered a part of the chromosome In most genera there is an enlargement or knob where each intranuclear chromosomal fiber joins the nuclear membrane Presently some of the astral rays become extranuclear chromosomal fibers by connecting with the knobs or 'kinetic bodies' of the intranuclear chromosomal fibers in the nuclear membrane When such a connection is established the chromosome is connected with the centriole Not all the connections are made at the same time, but eventually all the chromosomes are connected with the centrioles in this manner, half being connected with one centriole and half with the other, so that as the centrioles of the dividing cell separate the daughter chromosomes are moved to the poles The fibers composing the central spindle pull apart, and presently the achromatic figure begins to disappear, the last part to disappear being the extranuclear chromosomal fibers No other fibers are present during mitosis, and it appears to the writer that the so called interzonal fibers, sometimes described during mitosis, particularly in the anaphase, are either the fibers of the central spindle or connections between the two groups of daughter chromosomes which, in certain forms, pull out for a considerable distance before pulling in two

In the interphase the centrioles (and the centrosomes too in those genera where they are present) may be moved for a considerable distance by mechanical means without altering their appearance in the least In fact, it is only when the cell is completely

destroyed that they disappear And when the achromatic figure has been formed from the centrioles, it is possible not only to see that the daughter chromosomes are connected to the centrioles, but also to demonstrate such a connection by pulling either of the centrioles away from the nucleus the chromosomes moving with the centriole as it is pulled Such a procedure also demonstrates the elasticity of the extranuclear chromosomal fibers and those of the central spindle, for unless the centriole is pulled a considerable distance (far enough to break the fibers) from the nucleus, it and the chromosomes pulled with it immediately spring back into position when the tension is released Thus, in these organisms, there is not the slightest doubt regarding the existence of the centrioles, the formation of the achromatic figure from the centrioles the fibrillar nature of the achromatic figure and the rôle of the achromatic figure in nuclear division

The question naturally arises Are all centrioles like those of hypermastigote flagellates and do they function in the same manner? As already noted hypermastigote centrioles vary considerably in size and in the type of achromatic figure that arises from them In some genera the central spindle is flat and band like, in some it is cylindrical in some it is compact, and in some it is dispersed In certain genera the astral rays are fine and can not be seen so readily as in others and in those with fine astral rays the extranuclear chromosomal fibers are more difficult to see In brief, there is every gradation beginning with genera having large centrioles and a large achromatic figure which may be seen with a 16 mm objective and a 10X ocular and ending with those where the centrioles and achromatic figure may be seen only faintly with oil immersion objectives So that it is only a short step from hypermastigotes of the last category to the cells of other forms of life where, in fixed and stained material, the centrioles and the achromatic figure have the same appearance as those of hypermastigotes in living material In this connection it should be noted that in the polymastigotes *Saccinobaculus* and *Pyrsonympha* the intranuclear achromatic figure may be seen in living cells but the centrioles from which it arises can not be seen, and in fixed and stained material the centrioles can be seen in only one of the three species of *Saccinobaculus* There are evidently all gradations of centrioles, from the large, dense ones of certain hypermastigotes to the less dense and diffuse ones of other cells, and whether a centriole can be seen in living or in fixed and stained material depends on its nature and that of the cytoplasm or nucleoplasm in which it lies. The same is also true of the achromatic figure But the ability to demonstrate a centriole only under certain conditions of fixation and staining does not indicate that it is an artifact, nor does the inability to demonstrate it at all indicate that it is not present It merely means that its nature is such that it can only be seen under certain conditions or that it can not be seen at all with the aid of any known technique In any cell —and this includes practically all cells—where some type of an achromatic figure is formed, centriolic material must be present, it may be congregated into a large, dense, extranuclear body as in some hypermastigotes or, on the other hand, it may be rather generally scattered through the nucleus as in the cells of many vascular plants There is no reason why the centriole and the achromatic figure should be less variable in different types of cells than other organelles And the fact that the centriole in certain animal and plant cells give rise to flagella, as well as to the achromatic figure, does not appear to be sufficient reason for regarding it as another organelle, since in some generations (cell divisions), both in animals and plants, the centriole gives rise only to the achromatic figure, while in other generations it gives rise to flagella and the achromatic figure In such organisms, then, which are by no means few in number, the same body sometimes would be considered a centriole and at other times something else What appears to be the best explanation of the situation is that in certain forms the centriole still possesses the ability to give rise to locomotor organelles in addition to the achromatic figure while in other forms either it has never performed this dual function or this ability has been lost, or there is no longer any need for the centriole to produce locomotor organelles If there are cells where the locomotor organelles arise from a body that does not produce the achromatic figure, the term blepharoplast appears applicable to this body

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SCIENCE

VOL. 81 — FRIDAY, JUNE 21, 1935 — No 2112

SCIENCE A Weekly Journal devoted to the Advancement of Science, edited by J MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS
New York City Grand Central Terminal
Lancaster, Pa. Garrison N Y
Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building Washington D C

THE RESISTANCE OF FIXED TISSUE CELLS TO THE TOXIC ACTION OF CERTAIN CHEMICAL SUBSTANCES[1]

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ANY consideration of the general question of tissue resistance has of necessity to first take into account the two monuments in this division of understanding and later the particulate research which these initial contributions stimulated First, the biological conception of Metchnikoff[2] of the protection and the resistance afforded tissues through the activity of wandering cells, and second, the chemical or humoral theory of Ehrlich[3] which postulated the production on the part of tissues reacting to injurious agents of substances highly specific in nature which had the ability to bind or destroy those agents which had incited their formation The fundamental work of Metchnikoff has been amplified and made specific through investigations of a major character by Aschoff,[4] Mallory,[5] Maximow,[6] Sabin,[7] Gay,[8] Cunningham[9] and their pupils so that at the present time the wandering phagocytic cells of the

[1] This investigation was made possible through a grant from The Josiah Macy, Jr, Foundation. Address delivered before the General Session of The Federation of American Societies for Experimental Biology; Detroit, April 13, 1935

[2] Metchnikoff, "L'immunitié dans les maladies infectieuses." Mason et Cie, Paris, 1901

[3] Ehrlich, *Deut Med Wchnschr* 17 976, 1891

[4] Aschoff *Ergeb inn Med u Kinderh* 26 1, 1924

[5] Mallory, *Jour Exp Med*, 3 611, 1908

[6] Maximow, *Arch Path*, 4 557, 1927, *Arch exp Zellforsch*, 5 169, 1928

[7] Sabin, *Physiol. Rev*, 2 38, 1922

[8] Gay, The Harvey Lectures, 1930–31, Williams and Wilkins, Baltimore

[9] Cunningham, *Am. Jour Physiol*, 59 1, 1922

body and certain fixed phagocytic cells have become recognized as one of the most essential defense mechanisms which the organism utilizes against living agents of disease

The humoral theory of Ehrlich, though at first standing apart from the earlier conception of Metchnikoff, has through continued investigation not only established itself as an entity in a chemical sense, but such studies indicate the origin of many of these bodies of a specific chemical character to be intimately associated with the specific activity of different types of cells found in the macrophage system More and more the conception of Ehrlich takes its place as an integral and essential part of the biological defense mechanism first postulated by Metchnikoff

As far reaching in their applications as these two conceptions, or a combination of the two may be, there are certain types of tissue resistance which they fail to explain The congenital and acquired resistance of certain tissues to chemical substances has no cytological or humoral explanation the congenital tolerance of the parasympathetic endings of the rabbit for atropine when such endings have a normal degree of sensitivity to other agents acting through them, the acquired tolerance of the central nervous system to the alkaloids of opium, even though this tissue, as was shown by Rubsamen,[10] may contain a very high percentage of such bodies The development of "dye fast" and specifically "arsenic fast" protozoa,[11] especially the trypanosomes, whose resistance to such agents may be transmitted to subsequent generations of organisms,[12] furnishes a group example of acquired tissue resistance on the part of organisms for which there is no explanation

Tissue resistance not infrequently develops as a sequence to processes of repair Through inflammation or chemical degeneration, cells of functional value are lost and become replaced by entirely different types of cells which either have no functional value, or their type of function is so changed that they are no longer of value to the organism in a normal, functional sense The formation of fibrous tissue secondary to tissue destruction, the encystment of parasites or foreign bodies and the localization of an inflammatory area are familiar examples of such a process Somewhat different, but resembling this form of repair, is the shift in cell type which was observed by Wolbach,[13, 14] and Wolbach and Howe[15] in their studies of vitamin deficiency in which normal epithelium was replaced by keratinized cells. Here again tissue resistance is acquired, but it is not acquired by the formation of cells which are of functional value Such cell resistance developing as a result of a change in cell type is dependent upon a lack of exposure of the altered cells to the injurious agent. Tissue resistance should imply the ability of cells to function to some extent in a normal manner, to subject themselves to an injurious agent and to withstand in various degrees the action of such an agent Related to this type of resistance dependent upon injury followed by a repair process in which fixed tissue cells undergo a metaplasia, retaining in part their function and yet becoming resistant to injury, fall the experimental observations which form the basis of this communication

In experiments[16, 17] conducted many years ago, which were primarily concerned with a study of renal regeneration subsequent to an interference with the blood supply to the kidney, the observation was made that in such areas of restricted blood supply, the epithelial regeneration which occurred was of an abnormal type The environment created experimentally in such areas was unable to maintain the physical integrity of the highly specialized type of cell which occurs in the convoluted tubules but could maintain a flattened type of cell with less specialized cytological characteristics There was not then, and there is not now, any way to ascertain in the higher animals the functional value of such cells exclusive of other intimately related structures, the glomeruli

In a later study[18] of the naturally acquired chronic nephropathy of the dog this same type of cell was observed as having taken the place of cells in the convoluted tubules When such a shift in cell type had occurred as a reaction to injury during the course of a chronic nephritis it was found that such cells originating as a repair process were resistant to uranium nitrate, while the normal type of cell in this segment of the tubule had no resistance against this nephrotoxic agent Years later than this Gil y Gil[19] observed that the kidney of the rabbit, the seat of a chronic injury from uranium, developed a certain degree of resistance against this agent A similar observation was also made by Hunter[20] Recent studies[21, 22, 23] from this laboratory of the acute and

[10] Rubsamen, *Arch f exp Path u Pharm*, 59 227, 1908

[11] Voegtlin, Dyer and Miller, *Jour Pharm Exp Ther*, 25 55, 1924

[12] Woodruff, "Organic Adaptation to Environment," Yale University Press, New Haven, 1924

[13] Wolbach, *Jour Exp Med* 43 753, 1925

[14] Wolbach, *Archiv Path*, 5 239, 1928

[15] Wolbach and Howe, *Jour Exp Med*, 57 511, 1933

[16] MacNider, *Jour Med Research*, 19 425, 1911

[17] *Ibid*, 20 369, 1911

[18] *Ibid*, 29 177, 1916

[19] Gil y Gil, *Beit z path Anat, u Allg Path*, 72 621, 1924

[20] Hunter, *Ann Int Med*, 1 747, 1928

[21] MacNider, *Jour Exp Med*, 49 411, 1929

[22] MacNider, The Harvey Lectures, 1928–29, Williams and Wilkins Company, Baltimore, *Amer Jour Med Sci.*, 178 449, 1929

chronic nephritis induced in the dog by uranium nitrate have not only emphasized the selective affinity which uranium has for the convoluted tubule cells and the resistance which the kidney may acquire to this toxic agent, but certain of these studies have become more specific in their understanding of the nature of this resistance in that they have shown that it is dependent upon two factors first, the severity of the epithelial injury, and second, the type of fixed tissue cell which develops as a process of repair in such injured areas

If a slight epithelial injury be induced in the convoluted tubule cells of a young dog by the subcutaneous use of 2 mgs of uranium nitrate per kilogram, there develops evidence of degeneration in these cells which is followed by a process of repair which results in the formation of cells normal cytologically for this segment of the tubule When animals with this type of normal epithelial repair are subjected to a secondary intoxication by uranium, in the same amount per kilogram they fail to show any evidence of resistance to this nephrotoxic agent The epithelium undergoes a process of degeneration During these experiments other animals were intoxicated by 4 and by 6 mgs of uranium nitrate per kilogram with the development of a more severe type of injury to the convoluted tubule cells A large percentage of such animals failed to survive In those animals effecting a survival a study of biopsy material has shown the convoluted tubule segment to be repaired by an entirely different type of epithelial cell A cell metaplasia has developed with the formation of cells abnormal in their morphology for this portion of the tubule which are characterized by their flatness, an intensity of staining of both cytoplasm and nuclei, and a tendency to persist as syncytial structures When such animals are reintoxicated by uranium in the amount employed for the first intoxication or to an amount not exceeding 8 mgs per kilogram, the atypical type of epithelial replacement fails to undergo changes of degeneration As a reaction to a severe type of injury epithelial repair to the convoluted tubules has taken place by the formation of an abnormal type of epithelial cell which imparts to this segment of the tubule a high degree of resistance to the toxic action of this chemical substance The functional value of this type of epithelial replacement can not be directly ascertained

The question then arises, are such processes of repair which depend upon fixed cell metaplasia of such a nature that these cells having a functional value in turn subject themselves to the toxic action of this chemical and resist its toxic influence? In order to answer this question and for the purpose of ascertaining if the same factors influenced fixed cell resistance in other organs, the liver has been studied both functionally and structurally during phases of injury followed by periods of different types of cell repair

The fact was established through the investigations of Whipple and Sperry[24] that when chloroform was given to dogs under standard conditions there occurred a central necrosis of the liver lobules involving one half to two thirds of their area A technique similar to this has been employed to ascertain whether or not the livers of animals injured by uranium nitrate and subsequently repaired by different types of fixed cells has or has not acquired a resistance to chloroform when given by inhalation [25] During these experiments the functional effectiveness of the liver has been ascertained by the use of phenyltetrachlorphthalein, according to the technique developed by Rosenthal [26]

When young dogs are intoxicated by uranium nitrate given subcutaneously in the amount of 2 mgs per kilogram, there usually occurs by the third day evidence of hepatic dysfunction which is indicated by an increase in the initial plasma concentration of this dye and by a delay in its removal from the plasma Such a concentration has rarely gone above 13 per cent and the delay in the removal of the dye has not been prolonged beyond an hour At such a period of hepatic injury the epithelium has shown cloudy swelling an increase in granulation and an abnormal accumulation of stainable lipoid material Vacuolation and necrosis of the cells has usually been absent The vascular tissue of the liver and the bile duct epithelium do not participate in the injury Within eight to twenty days this degree of epithelial injury is repaired by the formation of a normal type of polyhedral epithelial cell and associated with such a repair, liver function as indicated by the use of phenoltetrachlorphthalein returns to its normal value At such period of liver recuperation the animals were starved for twenty four hours and anesthetized with chloroform for one and one half hours Such a procedure has caused the development of a central necrosis of the liver lobules, which is variable in its extent and which is associated with a depression in hepatic function A slight liver injury induced by uranium is followed by a fixed cell repair to the liver resulting in a restoration of liver function which is dependent upon the formation of a normal type of liver epithelium The liver, the seat of this type of repair process, has failed to acquire any resistance to chloroform The repaired hepatic cells undergo necrosis in the same location in the lobules and

[23] MacNider, SCIENCE, 63 103, 1931

[24] Whipple and Sperry, *Bull Johns Hopkins Hosp* 20 278, 1909

[25] MacNider, *Trans Ass Amer Physicians*, 49: 14, 1934

[26] Rosenthal, *Bull Johns Hopkins Hosp*, 33 432, 1922

in general to the same extent as occurs in the livers of normal dogs

In a second series of experiments an intoxication was induced by the use of 4 mgs of uranium nitrate per kilogram When the amount of uranium is increased to this extent a severer type of intoxication is established which may lead to the death of the animals In those animals which have effected a survival the experiments have had the following course As a result of the severe liver injury there occurs a higher initial plasma concentration of phenoltetrachlorphthalein which reaches its maximum between the fourth and sixth days of the injury A concentration as high as 32 per cent has been obtained at such a period The dye is not removed from the plasma in a two-hour period At such a stage of acute injury the hepatic epithelium has shown vacuolation with partial and in areas complete necrosis, a marked increase in stainable lipoid material in the better preserved cells with only a minor degree of invasion of such areas by polynuclear and monocytic cells

The repair to the liver from an injury of this severity is completed between the fourth and the tenth week The repair is accomplished by the formation of an atypical type of epithelium which is not patchy but is diffuse in its distribution The cells and cell cords are flattened, leaving between them greatly enlarged hepatic sinuses The cytoplasm of such epithelium has a dense appearance and stains intensely and evenly The nuclei are large in proportion to the surrounding cytoplasm and appear hyperchromatic In many of the liver cords the cells have not differentiated but remain as syncytial structures Associated with this type of liver repair there has developed an improvement in hepatic function which in the case of a few animals has returned to the normal There is evidence therefore that this type of epithelial cell is possessed of definite functional value

At such periods of liver repair associated with a partial restoration in liver function, chloroform has been given by inhalation in order to ascertain whether or not this type of cell had acquired any degree of resistance against this toxic chemical agent The animals were starved for twenty four hours and deeply anesthetized for three hours, an hour and a half in excess of the time necessary to induce liver necrosis in normal dogs and in dogs in which a liver repair had occurred through the formation of a normal type of epithelial cell In the group of animals now under consideration in which the liver repair had been effected through the formation of an atypical type of cell there was no histological evidence of liver injury At the termination of the periods of anesthesia the functional effectiveness of the liver in so far as its ability to remove phenoltetrachlorphthalein was concerned was variable In the larger number of animals at such a period the initial plasma concentration of the dye and the rate with which it was removed was greater than the concentration and rate of removal which the livers of such animals in a state of repair had established as their pathological normal In a smaller percentage of animals the functional value of the liver was not interfered with From these experiments it would appear that dependent upon the type of repair process provoked in the liver by the use of uranium, a resistance is acquired on the part of this organ to the toxic action of chloroform when it is given under standard conditions in an amount much in excess of that necessary to induce an injury to a normal type of liver cell

The question then arises concerning the degree of resistance which has been acquired by this type of cell Is the resistance complete, or is it relative to the amount of the toxic agent employed and the duration of the exposure of such resistant cells to it? The degree of resistance in this instance as is likely the case in all forms of tissue resistance is relative in its nature, as is shown by the fact that if animals which have acquired a liver resistance to chloroform when starved for twenty four hours and given chloroform for three hours be again starved not for twenty four but for forty eight hours and given chloroform for four hours on one day or for three hours on two successive days there then occurs a central injury to the liver lobules which if sufficiently extensive, is expressed by a reduction in hepatic function

During the thirteen years through which this general plan of investigation has been in effect dogs have been studied which on account of their age may be classified as senile animals Such animals have varied in age from eight to fourteen years, have shown the local manifestations of senility, are generally underweight for their variety, but without evidence of a definite process of disease In twenty-one of ninety two dogs which have fallen in this group, histological studies of the liver have shown the occurrence of an alteration in the structure of the hepatic epithelium similar to that which has been described as occurring in those animals which have survived a severe injury to the liver from uranium in which the liver repair was effected by the formation of an atypical type of hepatic epithelium There occurs therefore in a certain number of animals, in a group which may be designated as senile, a change in the type of epithelial structure of the liver When such animals are starved for twenty four hours and given chloroform by inhalation for one and one-half hours, there fails to develop a central necrosis of the liver lobules. The removal of phenoltetrachlorphthalein from the plasma is not interfered with If, however, the period of starvation be increased to forty-

eight hours and chloroform be given for four hours, a central injury to the liver lobule develops. These observations are of particular interest in that they show that a shift in cell type may develop in the liver without the use of an agent distinctly abnormal to this tissue, that the change may be acquired as a product of senility and that when it develops it imparts to the liver a degree of resistance to chloroform comparable to that induced by a process of repair following a severe hepatic injury from uranium nitrate.

Conclusions

(1) The observations which have been made concerning an acquired resistance of fixed tissue cells to chemical injury should be considered of a gross order and perhaps superficial in their nature. Studies of the mitochondria, the Golgi apparatus and the chemical constitution of such resistant cells afford important suggestions for investigation.

(2) The type of fixed cell response which develops in both the kidney and liver as a reaction to injury induced by uranium nitrate depends upon the severity of the injury to the epithelial structure of these organs. If the injury which is inflicted be slight as indicated by cytological changes of degeneration and in the case of the liver by but minor interference in one manifestation of its function, the process of repair results in the formation of a normal type of epithelial cell. This type of repair process is not associated with the acquisition on the part of the kidney of any degree of protection against subsequent intoxications by uranium or in the case of the liver against the toxic action of chloroform.

(3) If the injury to the epithelium of the kidney or the liver be of a sufficiently severe order, there occurs in such animals the development of a process of epithelial repair which is atypical in character and which imparts to the kidney a relative resistance against subsequent intoxications by uranium and in the liver a similar protection against the toxic action of chloroform.

(4) This protection is not dependent upon the development during the process of repair of a type of cell which is functionally inert and therefore one which does not subject itself to the action of the toxic agents. The morphologically altered hepatic epithelium maintains its functional effectiveness, as is indicated by its ability to remove phenoltetrachlorphthalein from the plasma and furthermore when such changed fixed tissue cells in the liver are subjected to the toxic action of chloroform in a concentration and for a duration far in excess of that employed under standard conditions, they show evidence of injury and liver function becomes depressed.

(5) The observation has been made of the natural occurrence in the livers of certain senile animals of a type of morphologically altered epithelium similar in its configuration and staining reactions to the cells which may develop in the liver reacting to a severe injury from uranium nitrate. Such cells impart to the livers of senile animals an acquired resistance to the toxic action of chloroform.

(6) It would appear from these experiments that a tissue resistance to certain chemical substances may depend upon the development in tissues as a process of repair following injury of an altered type of resistant fixed tissue cell which maintains a sufficient degree of functional effectiveness to enable the organism as a whole to survive.

OBITUARY

EDWIN BRANT FROST

1866–1935

Edwin Brant Frost was born on July 14, 1866, at the pleasant town of Brattleboro in the southeastern corner of Vermont. It was here or in the immediate neighborhood that most of his forbears for several generations had lived and flourished. The first of the name in this country was Edmund Frost, who came to Boston in 1634, his grandchildren moving west to New Hampshire and Vermont. Edwin was the second son of Carleton Pennington Frost (1830–1896), who practiced medicine in Brattleboro and neighboring towns until 1871, when he moved with his family to Hanover, New Hampshire, there to be a professor in the Dartmouth Medical School and afterwards dean of the school and a trustee of the college.

Edwin was graduated A.B. at Dartmouth in 1886. The year following he continued postgraduate work at Dartmouth, taught school in a nearby village and at the end of the year spent a few months at Princeton, where he came under the influence of Charles Augustus Young (1834–1908), then perhaps the leading teacher of astronomy in this country. An appointment to an instructorship at Dartmouth came in 1887. At that time advanced work in astronomy and in almost every other branch of science meant a year or more in Europe. Accordingly, Frost secured a two-years leave (1890–1892) to visit most of the European observatories and to spend the second year at Potsdam in Germany, where Vogel was establishing an observatory devoted especially to the new science of astrophysics and where he had gathered around him an

exceptionally brilliant staff, all of them leaders in their chosen fields Scheiner, Muller, Kempf, Wilsing, Hartmann, Ludendorff, Eberhard, Lohse Frost thus had an opportunity to come into contact with a group that it would have been difficult to match at a single institution either in that day or during the twenty years to follow When he returned to Dartmouth in 1892 it was as assistant professor, and this promotion was followed in 1895 (when he was only twenty nine years of age) by a full professorship and the director ship of the Dartmouth Observatory

While at Potsdam Frost made arrangements with Scheiner to translate into English the latter's 'Spec tralanalyse der Gestirne" (1891) Frost's work ap peared in 1894 It is more than a translation, for although there was only three or four years between the two books, much progress had been made in astro nomical spectroscopy in the interval, and Frost brought the work up to date besides incorporating some new matter in the form of tables Frost's book played an important part in the rapid development of the science in this country, and until very recently it remained the standard work on the subject in our language

The lines along which Frost's career was likely to develop must have seemed unusually clear to him at this time, and doubtless he looked forward to a long term of usefulness to his Alma Mater But a series of apparently remote events rapidly and completely changed his outlook James Edward Keeler (1857–1900) had left the Lick Observatory in 1892 to take charge of the Allegheny Observatory in Pittsburgh There he at once made a striking series of spectro scopic observations with the meager equipment at his disposal One effect of this success was to give great impetus to a movement to erect a new Allegheny Observatory, with a thirty inch refractor as its prin cipal instrument When something more than half of the amount of money necessary for this project had been raised, business conditions in Pittsburgh caused the fund to halt and Keeler had to look forward to some additional years with the old equipment Those were the days when Catherine Bruce, of New York City, was devoting a good deal of her income to further astronomical research in all quarters of the globe In 1897, Dr George E Hale, director of the recently completed Yerkes Observatory at Williams Bay, Wis consin, successfully applied to Miss Bruce for a grant sufficient to bring Keeler to the Yerkes Observatory for five years and to set on foot an extensive program of spectroscopic observations of the stars He was to go to the Yerkes in the summer of 1898, but in the spring of that year he received a most unexpected call to succeed Holden as director of the Lick Observatory In common with every one else concerned he felt that he could not refuse this call For the place thus left open at the Yerkes Observatory Dr Hale naturally turned to Professor Frost, who took up his duties at Williams Bay in the summer of 1898, expecting to stay for five years only But before the end of this term the outlook had again changed, for Hale had been organizing what was at first an expedition from the Yerkes Observatory to California to observe the sun under more favorable climatic conditions As every one knows, this expedition grew into the Mount Wilson Observatory In the two years following 1903 much of the responsibility for the conduct of the Yerkes Observatory fell to Frost On Hale's resigna tion as director in 1905, Frost was appointed to suc ceed him in June of that year

The late Dr de Sitter once remarked to me that American astronomers were, with a few conspicuous exceptions, a group of specialists, and he added with a smile that he did not know whether this was an element of weakness or of strength for the general progress of the science His remark would have ap plied with much force to Frost, who persisted in devoting his energies to the spectroscopy of "early type stars to the practical exclusion of every other subject Primarily for this purpose the Bruce spectro graph was constructed in 1900 largely from his specifi cations and under his supervision With this instru ment and with the able collaboration of Walter S Adams, now director of the Mount Wilson Observa tory, he measured the radial velocities of many 'helium stars" or 'Orion stars," as they were then called (now they are more logically designated as B stars, following the Draper Classification), and dis covered their most important characteristics It was shown that their space velocities are small as compared with those of later type stars and that there is a slight but unmistakable tendency for these stars to re cede from our system as a whole, as if they formed an expanding group These facts were later more fully developed by Campbell, their explanation is closely interwoven with recent important discoveries in astronomy and physics

Frost also showed from changes in radial velocity that a surprising number of B type stars are close binary systems, perhaps as many as one in every three On several occasions I have witnessed his discovery of such a binary from a single photograph of its spec trum This sounds like an impossibility, but the ex planation is simple Even in those days (around 1904) he was extremely nearsighted, and could see well an object not more than an inch from his eye, thus, as he used to say, by simply pushing his glasses up he always had at his disposal a magnifying power of about ten diameters After he had secured a spectrogram and developed it the next morning, he would

examine it in this way, sometimes before it was dry If he saw the lines considerably displaced from their normal positions, he knew that it was extremely unlikely that this was because of the star's large space velocity, since, as we have said, he had found that such velocities are always small for B type stars, the displacements must then be due to orbital motion, and so indeed they invariably proved to be when later he could examine a series of plates of that star

Frost's place in astronomy is not to be judged on the basis of his researches alone We have already mentioned his translation of Scheiner's work and the part this translation played For more than thirty years his was the chief responsibility for editing the *Astrophysical Journal,* "an international review of spectroscopy and astronomical physics," founded in 1895 by Hale and Keeler, and now in its eighty first semiannual volume One might say of Frost as Frost used to say of Burnham, "he is the best skeptic I know" As a result of this quality of judicious conservatism, the *Astrophysical Journal* has had little to regret in the way of hasty or ill advised publication In addition, he had an unusually sensitive feeling for language, which showed itself not only in his English but quite as well in German and nearly as well in French

The last years of his life form a sad story, but an inspiring one as well From early childhood he had had trouble with his eyes This became acute by 1907 and necessitated long periods of complete rest for his eyes In 1915 the retina in one eye became detached and within a few months he completely lost the sight in this eye, never to regain it A few years later a cataract began to form in his other eye and grew worse and worse until he became totally blind In spite of this heavy handicap, he managed for several years to continue his work as director of the observatory, but finally felt compelled to retire in 1933

In the first year of his retirement he dictated to his wife, and dedicated to her, his autobiography, under the title "An Astronomer's Life"[1] The volume is important as a contribution to the history of present day science His story is told with fascinating charm, and I for one found it impossible to put it down before I had finished it It is much more than a setting down of facts or a collection of well told stories As a record of courage and good sportsmanship in the face of one of life's severest disasters it can not fail to move every reader In all his years of complete darkness he never lost his sense of humor To the last he had a way of ignoring his blindness in conversation and whimsically using terms and expressions that one should ordinarily expect only from those who can see

Early in April of this year Frost went to a Chicago hospital for observation The cause of his ailment was diagnosed as gallstones After some hesitation on account of his age (he was in his sixty ninth year), an operation was performed on May 6 His condition improved for a few days but then his strength rapidly waned until the end came on May 12

Among the honors that came to him were honorary degrees from Dartmouth and Cambridge, membership in the National Academy of Sciences, the American Philosophical Society and the American Academy of Arts and Sciences, honorary membership or the equivalent in the Royal Astronomical Society (London), Societa degli Spettroscopisti Italiani, astronomical societies in Mexico, Canada and Russia

Dr Frost was married in 1896 to Mary Hazard, of Boston, she and their three children survive him, as does his elder brother, who, like their father before them, is a professor in the Dartmouth Medical School

FRANK SCHLESINGER

YALE UNIVERSITY OBSERVATORY
JUNE 4, 1935

[1] Houghton Mifflin Company, Boston and New York

REGINALD OLIVER HERZOG

R O HERZOG was born in Vienna in 1878 His father was a newspaperman After finishing his secondary education, Herzog studied chemistry at the University of Vienna under Lieben and there took his doctor's degree with a paper on organic chemistry His interest, however, was at that time in physiological chemistry and so he went first to Heidelberg, where he worked in the Physiological Laboratory under Kossel, then to Utrecht and to Kiel His first papers of this interval (1902–1905), nine in number, were concerned with straight physiological chemistry But soon his interest branched out He started to work on fermentation and the action of fungi That led him deeper into industrial questions and he published papers on the theory of tanning and disinfection On the other hand, he began to apply the methods of physical chemistry to ferment reactions, studying their kinetics and the influence of temperature upon them In the meantime, he had moved to the Technische Hochschule at Karlsruhe, where he became first privatdozent, then ausserordentlicher (associate) professor At that time, Haber was professor of physical chemistry there, working on the synthesis of ammonia With him, Herzog formed a friendship that lasted until Haber's death in 1933

In Karlsruhe, Herzog continued along his previous lines (physiological chemistry in general, fermentation), but he started also on two new subjects that were to occupy him through the rest of his life He attempted to get a better insight into the constitution of the natural substances, many of which are colloidal, by physico-chemical methods With this in mind, he instigated a number of experimental and theoretical

investigations on diffusion Making use of recent formulas of Einstein, he showed how it was possible to use the diffusion coefficient to determine the size of large molecules Secondly, he got interested in the connection between chemical structure and physical properties He translated the text book of Smiles with that title from the original English, this became the standard work on the subject in German After a short stay in Berlin, he was called in 1912 as full professor of mycology to the Technische Hochschule in Prague But at the outbreak of the war his friend Haber, who in the meantime had become director of the Kaiser Wilhelm Institut for Physical Chemistry in Berlin, had him transferred there, where he worked on the improvement of the cloth and rubber material for gas masks After the war he returned shortly to Prague, but in 1921 he was made director of the newly founded Kaiser Wilhelm Institut of Textile Chemistry Here, as direct neighbor of Haber, he found himself in an ideal position He was rid of the teaching he disliked He was at the head of a laboratory, which he could organize, and at the same time he could work with industry, consulting and advising His laboratory devoted half its work to technical questions, but half of it was devoted to purely scientific problems Herzog succeeded in picking out young men who were destined to make their place in chemistry Ewald, now professor in Stuttgart, Polanyi, now professor in Manchester, Mark, now professor in Vienna, Schmid, now in Freiburg in Switzerland, Smekal, now in Halle, Bergmann in Dresden, now in New York, and Weissenberg worked there The problems selected bore on the fundamentals of textile structure as the clue to its properties And so Herzog started the new tool, x ray investigation of structures, on natural or ganic matter The concept of fiber structure (Polanyi) was born here, and investigations on the structure of textile fibers, wood and chitin were made

A large group of investigations centered around the strength of fibers and gave rise to a group of papers on gliding and stretching of metals, which have contributed greatly to our understanding of the strength of metals Of course, purely chemical problems were not neglected

In recent years, the depression forced the curtailment of the purely scientific work, as the institute was mainly supported by industry A large part of Herzog's time began to be occupied with the search for money to keep the institute up But he did not neglect his own work and turned again his attention to the fundamental question of the structure of glasses and liquids, to the nature of viscosity and the like He was also editor of an Encyclopedia on the technology of textile materials. His list of publications contains 52 articles for 1901–1914, 91 articles from 1921 on

In the fall of 1933 he was retired from his position and accepted a professorship at the reorganized University of Istanbul (Constantinople, Turkey) At the beginning he felt the change very strongly, but seemed after some time to get better accommodated to it. In the beginning of 1935 Mrs Herzog, who was suffering from a chronic knee ailment, and he went to Zurich in Switzerland for medical treatment His own health was bad Since the war he had been suffering deeply under the general conditions of the world His idealism and scientific attitude felt deeply hurt by the hate and unreason rampant everywhere In a fit of depression he took his life on February 4.

K. F HERZFELD

THE JOHNS HOPKINS UNIVERSITY

MEMORIAL TO CHARLES DARWIN

PERMISSION to erect a memorial to Charles Darwin in the Galapagos Islands to commemorate his visit there 100 years ago, according to *The Christian Science Monitor,* has been granted to the Darwin Memorial Expedition by President Velasco Ibarra of Ecuador The memorial, it was indicated, will be in the form of a scientific research station, the establishment of which "would make available to present day natural scientists from all over the world an opportunity to study at first hand Galapagos flora and fauna, whose primitive state is to day as completely remote from the encroachments of civilization as it was upon Darwin's epochal sojourn there a century ago"

In addition to the scientific research station, a monolith will be erected on Chatham Island, one of the most important of the group This monolith will bear commemorative bas reliefs on each of its four faces and will be topped by a replica of the bronze bust of Darwin now in the hall of biology of the American Museum of Natural History Dedication of the memorial has been fixed for September 6

Arrangements for the memorial were made with the Government of Ecuador by Dr B W von Hagen, leader of the expedition, who is now in Ecuador carrying on ethnological geographical and biological surveys of the coast and hinterland

RECENT DEATHS

EDWARD SALISBURY DANA, tutor and professor of physics at Yale University from 1874 until his retirement as professor emeritus in 1918, curator of mineralogy from 1875 to 1920, died on June 16, in his eighty-sixth year

DR LEÓN M GUERRERO died on April 13 The Executive Board of the National Research Council of the Philippine Islands have passed resolutions in his memory which refer to his work in the following

terms "Dr León M Guerrero was a Filipino scientist who rendered invaluable services in science to his country and his people in different epochs of Philippine history Through his untiring efforts and painstaking research great achievements have been recorded in the study of Philippine medicinal plants"

SCIENTIFIC EVENTS

THE DEDICATION OF THE RICHARD T FISHER MEMORIAL

ON June 9, beneath a cluster of ancient white pine hemlock and hardwood—a most appropriate setting—President James B Conant of Harvard University assisted in the dedication of a bronze memorial tablet to the late Professor R T Fisher The ceremony was held at noon, on the Tom Swamp Tract of the Harvard Forest at Petersham, Mass Despite the intermittent heavy rain, some one hundred and fifty friends, relatives, alumni of the Harvard Forest School and professional colleagues were present The site for the memorial is a lovely woodsy spot, and is regarded as singularly fitting, inasmuch as Professor Fisher often came there to study and to photograph the interesting wild life in the game sanctuary of which this area is a part

John S Ames, '01, president of the Forest School Alumni Association and donor of the lands making up the Harvard Forest, presided, and in a brief address told how the tract was obtained and how it had become the oldest managed forest in the United States He further mentioned how justly proud Professor Fisher was of its growth and of the increasing number of visits made by technical foresters from various portions of the world

Henry H Tryon, '12, director of the Black Rock Forest at Cornwall on Hudson, N Y, and chairman of the Fisher Memorial Committee, spoke briefly of the well nigh unanimous admiration and loyal affection which the alumni held for their former director and added that there could be no more fitting place for the memorial than this spot, where he loved to come

President Conant, before lifting the simple spray of spruce and larch which covered the tablet, touched perhaps the true dedicatory note ' Professor Fisher was the real creator of this forest His untimely death prevented the completion of many well laid plans that he had in the making His death will even more closely unite the forest with Harvard University Professor Fisher was continually laying plans for the advancement of this wonderful work, it was only a short time before his sudden death that he discussed with me at some length the future of the work here These plans now rest with us to carry out On behalf of the Governing Board of Harvard University I accept this memorial with a full sense of the responsibility which is implied therein and with a renewed gratitude for Professor Fisher s outstanding work"

Those present included Mr and Mrs Peter Frothingham, Mr and Mrs William James, Henry James, Dr Thomas Barbour, Dr E G Stillman, E S Bryant, Dean George H Chase, A H Upham, Wm G Howard, state forester of New York, H O Cook, state forester of Massachusetts, Mrs George R Agassiz, Dr R H Wetmore, Professor Henry V Hubbard, Dr John C Phillips Professor Irving W Bailey, Professor Harlow Shapley, and many others —*A Correspondent*

THE SAN FRANCISCO MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE rise of the chemical industry on the Pacific Coast will be emphasized at the ninetieth meeting of the American Chemical Society which will be held in San Francisco from August 19 to 23 Chemists from all over the country will participate Petroleum, wine making vitamins and new uses for wood will be special fields of discussion

Dr Edward C Franklin, professor emeritus at Stanford University known for his researches in liquid ammonia solutions which opened up a new field in organic chemistry has been appointed honorary chairman of the convention Professor Franklin is the holder of the Willard Gibbs Medal Dr Arthur Lachman, of the University of California, has been named general chairman

Most of the professional divisions will hold sessions. The Division of Agricultural and Food Chemistry and the Division of Industrial and Engineering Chemistry will conduct a joint symposium on the chemistry and technology of wine

A joint session of the Division of Petroleum Chemistry and the Division of Industrial and Engineering Chemistry will discuss ' Solvent Extraction and Solvent Dewaxing of Lubricating Oils." The Petroleum and Gas and Fuel Chemistry Divisions will sponsor a symposium on the utilization of natural gas hydrocarbons.

Wood as the raw material for chemical commodities will be the subject of another symposium of the Division of Industrial and Engineering Chemistry Joint symposia on vitamins and the minor elements of animal nutrition are planned by the Divisions of Medicinal Chemistry, Biological Chemistry and Agricultural and Food Chemistry Professor Roe E Rem

ington, of the Medical College of South Carolina, will preside

Sessions will be devoted to other fields of chemistry, including cellulose, colloids gas and fuel, chemical education paint and varnish sugar and physical and inorganic chemistry The presidential address will be delivered by Professor Roger Adams, of the University of Illinois

Dr William Albert Noyes emeritus director of the laboratories of the University of Illinois, will receive the Priestley Medal the highest honor of the American Chemical Society, which is bestowed every three years 'for distinguished service to chemistry" The American Chemical Society Award in Pure Chemistry of $1,000 will be presented to Dr Raymond M Fuoss, of Brown University

GRANTS IN AID OF RESEARCH FOR 1936 OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

From various donors, the association has received in the past funds with the provision that the income thereof be used in making small grants for the encouragement of research The allotment of these funds is assigned to the Committee on Grants Within recent years, the committee has been inclined to prefer recommending the appropriation of sums to aid in the completion of important projects already initiated or to supply apparatus or facilities in circumstances where adequate funds are not otherwise available The committee has ordinarily at its disposal the sum of $3 000

Individual grants have previously been limited to amounts of less than $500, and many smaller sums have been useful in meeting emergency needs or such as are not covered by other agencies Applications for grants are filed on special blanks which may be secured from the office of the permanent secretary It is important that each application be supported by letters from at least two sponsors who are personally acquainted both with the applicant and with the project and are able to speak specifically regarding both items

The membership of the committee for the current year is as follows Arthur H Compton (1937) (for physics), University of Chicago, J B Macelwane (1936) (for geology), St Louis University, William Crocker (1935) (for botany), Boyce Thompson Institute, Philip Fox (1935) (for astronomy), Adler Planetarium, McKeen Cattell (1935) (for medical sciences), Cornell Medical School, M Gomberg (1935) (for chemistry), University of Michigan, C C Little (1937) (for zoology), Jackson Memorial Laboratory, Walter R Miles (1936) (for psychology), Yale University The committee prefers that all correspondence be addressed to the permanent secretary and not to individual members The fiscal year of the association opens on October 1 and closes on September 30 following All grants not utilized within the year normally revert to the treasury of the association on October 1

Applications for grants for 1936 must be received at the permanent secretary's office in Washington, D C, on or before October 30 Reports which are incomplete or late in arrival can not be considered for the year 1936 The report of the committee is laid before the executive committee and the council at the annual meeting in December and payment of approved grants is made by the treasurer following that meeting Unused portions of grants should be returned on October 1 of each year

Publications including results obtained by virtue of the assistance rendered through grants should contain due acknowledgment of the aid furnished by the association Recipients of grants are expected to make at least one report, which should be filed with the permanent secretary not later than October of the year for which the grant was made In case completion of the report is delayed notice should be sent to the permanent secretary's office, and a statement of the results obtained in the research should be made at the time the report is filed

Henry B Ward,
Permanent Secretary

BIRTHDAY HONORS OF THE KING OF ENGLAND

As cabled from Europe and announced in Science the birthday honors of King George of England included the Order of Merit of the British Empire conferred on Sir Frederick Gowland Hopkins, president of the Royal Society, "in recognition of his eminent services to biochemistry, especially in connection with the discovery of vitamins" A baronetcy was conferred for public services on Dr Evan Williams, president of the Mining Association of Great Britain

Other honors include

Knights Bachelors

Noel Ashbridge, chief engineer of the British Broadcasting Corporation

Professor Joseph Barcroft, professor of physiology, University of Cambridge

Dr Arthur John Hall, emeritus professor of medicine, University of Sheffield, for distinguished service to medicine and medical science, with special reference to problems of the health of industrial workers

John Hepburn Milne Home, vice-chairman, Advisory Council to Department of Agriculture for Scotland, for services to agriculture

Patrick Playfair Laidlaw, pathologist to the Medical

Research Council, for distinguished service to medical science

Arthur Pugh, general secretary of the Iron and Steel Trades Confederation and of the British Iron Steel and Kindred Trades Association

The Order of Knight Companion of the British Empire

Dr John Cunningham M Lennan professor emeritus and visiting professor of physics University of Toronto, for fundamental discoveries in physics and for scientific services

The Order of Companion of the Bath

Dr William Thomas Calman keeper of zoology British Museum of Natural History president of the Linnean Society of London

Dr Frank Sturdy Sinnatt director of fuel research Department of Scientific and Industrial Research

AWARDS IN THE SCIENCES OF THE AMERICAN MEDICAL ASSOCIATION

IN the Class I exhibits at the meeting of the American Medical Association at Atlantic City the gold medal was awarded to an exhibit showing ergotocin a crystalline form of the active principle in ergot, discovered after three years of research by the cooperative efforts of three physicians Dr M Edward Davis, Dr Fred L Adair and Dr Gerald Rogers, and two chemists, Dr M S Kharasch and Dr Romeo R Legault

The silver medal was awarded to Drs Leonard G Rowntree, J H Clark and Arthur Steinberg, of the Philadelphia Institute for Medical Research and Dr A M Hanson, Faribault, Minn, for original investigations on the biological effects of the thymus and pineal glands

The bronze medal was given to Drs Jane Sands Robb, J G Fred Hiss and R C Robb, for original investigations on heart muscle bundle physiology and experimental coronary lesions

Certificates of merit were awarded to Dr Bede J Harrison, of the Vancouver General Hospital, Drs Aaron E Kanter Carl P Bauer and Arthur H Klawans, of Rush Medical College, University of Chicago and Drs Isaac Schour and A G Brodie of the University of Illinois College of Dentistry

The gold medal in Class II was awarded to Drs Stuart Harrington and Willis S Lemon, of the Mayo Foundation for Medical Education and Research, Rochester, Minn, 'for excellent presentation of an exhibit illustrating the surgical treatment and clinical manifestations of various types of diaphragmatic hernia [inverted stomach] and intra thoracic tumors"

The silver medal given for exhibits that do not exemplify purely experimental studies, was given to Drs David W Mackenzie and Alexander B Wallace, of the Royal Victoria Hospital, Montreal, for their exhibit on lymphatic studies The bronze medal went to Dr James Harold Mendel of Philadelphia for his exhibit on eardrums

SCIENTIFIC NOTES AND NEWS

THE summer meeting of the American Association for the Advancement of Science opens at the University of Minnesota, Minneapolis, on June 24, under the presidency of Dr Karl T Compton, president of the Massachusetts Institute of Technology The opening session on Monday evening will be a joint meeting with the Minnesota State Medical Association with an address on "Diseases of the Blood" by Dr W P Murphy, which will be followed by a reception given by Dr Lotus D Coffman, of the University of Minnesota, and Mrs Coffman The Maiben lecture will be given on Tuesday evening by Dr Richard P Strong, and there will be other evening lectures by Dr Isaiah Bowman, Dr W F G Swann and Dr Philip Fox The full preliminary program will be found in the issue of SCIENCE for May 24

THE Barnard gold medal "for meritorious service to science" of Columbia University has been awarded to Dr Edwin P Hubble, astronomer of the Mount Wilson Observatory This medal was founded in 1889 and is awarded every five years on the recommendation of the National Academy of Sciences

THE gold medal of the Linnean Society of London was presented at its anniversary meeting on May 24 to Dr David Prain, until his retirement in 1922 director of the Royal Botanic Gardens at Kew, in recognition of his services to botany" Dr W T Calman delivered the address of the president on The Meaning of Biological Classification"

THE council of the Royal Empire Society has awarded its gold medal for 1935 to Sir Wilfred Grenfell, 'in recognition of his services to the Empire and of the excellence of his book, The Romance of Labrador'"

THE degree of doctor of laws was conferred at the commencement of the University of Pennsylvania on Dr Charles Russ Richards, mechanical engineer, retiring president of Lehigh University, and on Dr Isaiah Bowman, director of the American Geographical Society, chairman of the National Research Council and president-elect of the Johns Hopkins University

HONORARY degrees conferred by Wesleyan University included the doctorate of science on Dr George

H. Whipple, professor of pathology of the School of Medicine and Dentistry at the University of Rochester.

THE degree of doctor of engineering has been conferred by the Polytechnic Institute of Brooklyn on Dr. Charles F. Scott, professor emeritus of electrical engineering at Yale University, and the degree of doctor of science on Professor Roger Adams, head of the department of organic chemistry at the University of Illinois.

At the commencement of Temple University, Philadelphia, the doctorate of laws was conferred on Dr. Edward Martin, emeritus professor of surgery at the University of Pennsylvania, and the doctorate of science on William H. Meese, vice-president of the Western Electric Company, Baltimore.

THE degree of doctor of laws was conferred by New York University on June 10 on Frederick Trubee Davison, president of the American Museum of Natural History.

OFFICERS of the American Medical Association were elected on June 13 at the Atlantic City meeting as follows: *President-elect,* Dr. J. Tate Mason, of Seattle; *Vice-president,* Dr. Kenneth M. Lynch, of Charleston, S. C.; *Secretary,* Dr. Olin West, of Chicago (reelected); *Treasurer,* Dr. Herman L. Kretschmer, of Chicago (reelected); *Speaker of the House of Delegates,* Dr. Nathan B. Van Etten, of New York; *Vice-speaker,* Dr. H. H. Shoulders, of Nashville, Tenn. The house of delegates voted to accept the invitation to hold the 1936 convention in Kansas City, Mo.

THE officers, executive committee and members of the Division of Geology and Geography, National Research Council, for the year beginning July 1 are as follows: *Chairman,* Edson S. Bastin; *Vice-chairman,* W. L. G. Joerg; *Executive Committee,* Edson S. Bastin, W. L. G. Joerg, A. F. Buddington, Charles Butts, W. F. Foshag and Robert S. Platt; *Representatives of Societies,* Donald C. Barton and A. F. Buddington, Geological Society of America; W. F. Foshag, Mineralogical Society of America; Charles Butts, Paleontological Society; C. F. Marbut and Robert S. Platt, Association of American Geographers; W. L. G. Joerg, American Geographical Society; Thomas B. Nolan, Society of Economic Geologists; F. H. Lahee, American Association of Petroleum Geologists; *Members at Large,* Florence Bascom, Edson S. Bastin and Ellsworth Huntington.

AT the seventeenth annual meeting of the American Society of Mammalogists held at the Carnegie Museum, Pittsburgh, from April 30 to May 4, officers elected for the coming year are: *President,* H. E. Anthony; *Vice-presidents,* Joseph Grinnell, E. A. Preble; *Recording Secretary,* Robert K. Enders; *Corresponding Secretary,* William H. Burt; *Treasurer,* Mrs. Viola S. Snyder; *Editor,* A. Brazier Howell; *Directors,* class of 1935–1937, Remington Kellogg, A. Brazier Howell, W. E. Saunders, Harold J. Coolidge, Jr., William J. Hamilton, Jr. Seventy-one members were present at the meeting. These came from thirteen states and two Canadian provinces, and thirty-five papers, dealing with various phases of mammalogy, were presented. The next annual meeting will be held at the Academy of Natural Sciences in Philadelphia.

AT the annual installation banquet of the Western Reserve University Chapter of the Society of the Sigma Xi, the following officers for 1935–36 were installed: *President,* J. P. Visscher; *Vice-president,* C. J. Wiggers; *Secretary,* W. M. Krogman; *Treasurer,* Frank Hovorka. The address of the evening, under the joint auspices of the Brush Foundation and the Society of Sigma Xi, was given by Professor C. U. Ariëns Kappers, director of the Central Institute for Brain Research, Amsterdam, on "The Brain of Prehistoric and Recent Races of Man."

THE Botanical Society of New Orleans held its annual dinner on June 7, and elected the following officers for the year 1935–36: Ronald B. Craig, associate forest economist of the Southern Forest Experiment Station, *president,* to succeed Dr. William T. Penfound, professor in the department of botany of Tulane University; James M. McArthur, director of nature study and gardening of the Orleans parish public schools, *vice-president;* Dr. Minna F. Koch, morphologist, *secretary,* and Philip C. Wheeler, associate forest economist, *treasurer.*

DR. LINUS H. JONES, assistant research professor of botany at the Massachusetts State College, was elected secretary of the New England section of the American Society of Plant Physiologists at the recent meeting at the University of New Hampshire. Dr. Walter S. Eisenmenger, head of the department of agronomy, was reelected to the executive board.

PROFESSOR PIETER ZEEMAN has retired from the professorship of physics and directorship of the Physical Institute of the University of Amsterdam, having reached his seventieth birthday. *Nature* reports that in order to allow his many admirers an opportunity of showing their appreciation of his important contributions to science, it is proposed that a jubilee volume be published, to which thirty distinguished physicists have already promised contributions, and that a Zeeman fund, a Zeeman medal or some similar method of encouraging research be founded. A general committee with representatives from all parts of the world has been formed with an executive commit-

tee under Professor J D van der Waals, Jr, with T L de Bruin, of 33 Gerard Terborgstraat, Amsterdam S., as secretary and treasurer to carry out the proposals, and an appeal is now made for funds in support of the scheme.

AT Harvard University, Dr John Hasbrouck Van Vleck has been appointed to a professorship of mathematical physics, Dr Harry Rowe Mimno, tutor, has been made assistant professor of physics, and Frederick Vinton, tutor, has been appointed instructor in physics and communication engineering and tutor in the division of physical sciences

AT the University of Colorado, Dr P G Worcester has been promoted from acting head to head of the department of geology, Dr Warren O Thompson from assistant to associate professor of geology Dr Howard Stagner, from assistant to instructor in geology, and Dr L O Quam, from part time to full time instructor in geography

DR HORACE J FRASER, research geologist with the International Nickel Company at Sudbury, Ontario has been appointed assistant professor of mineralogy and mineragraphy at the California Institute of Technology

DR. HENRY KLEIN, formerly associated with Dr E V McCollum at the School of Hygiene and Public Health, the Johns Hopkins University, has been appointed to the staff of the Dental College of the University of Detroit

AT the University of London, the chair of civil and mechanical engineering, King's College, has been filled by the appointment of Dr C H Lobban, university reader in civil engineering at the college, and the chair of physiology, St Mary's Hospital Medical School, by the appointment of Dr A St G J McC Huggett, reader in pharmacology and member of the department of physiology at the University of Leeds

EDGAR SYDENSTRICKER was appointed scientific director of the Milbank Memorial Fund on June 1 From 1920 to 1928 he was in charge of statistical research in the U S Public Health Service and since then has been consulting statistician to the service and director of the research staff of the Milbank Fund

DR. J G HILDEBRAND, JR., a graduate of Columbia University, has recently joined the staff of Gustavus J Esselen, Inc He will have charge of a new laboratory devoted to the application of electronics to industry He will also assist in the application of the principles of motion picture photography to the recording and interpretation of the results of scientific investigations

THE British Minister of Health and the Secretary of State for Scotland have appointed an Advisory Committee with the following terms of reference To inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition The chairman of the committee is Lord Luke Members include Professor E P Cathcart, Sir F Gowland Hopkins, Professor E Mellanby and Sir John Boyd Orr

DR FRANCIS F LLOYD, emeritus professor of botany at McGill University will visit Capetown and Australia during the next fifteen months for the particular purpose of studying Utricularia in the field He will visit Brisbane in the summer season and move south and west so as to spend some months in Perth, Southwest Australia during the following winter season

GUESTS for the summer at the Morris Biological Farm of the Wistar Institute of Anatomy include Dr O Larsell professor of anatomy at the University of Oregon who will continue his studies on the development of the nervous system of the opossum, Dr Edward L Corey assistant professor of physiology at the University of Virginia who will work on the central nervous system by operative procedures on pregnant rats, and Dr Rush Elliott associate professor of comparative anatomy at Ohio University who will carry on neurological work with Dr A W Angulo, associate member of the institute

DR KIRTLEY F MATHER professor of geology at Harvard University, gave the baccalaureate address at Purdue University

DR JESSE HAYES WHITE formerly professor of psychology at the University of Pittsburgh and ex president of James Millikin University, gave the commencement address at Upper Iowa University on June 10

SIR ARTHUR EDDINGTON gave an address on "The Physics of the Sun" on the occasion of the dedication on June 11 of the new solar telescope provided for Professor H H Plaskett at the University Observatory, Oxford

THE annual meeting of the Federation of American Societies for Experimental Biology will be held in Washington, D C, from March 25 to 28, 1936

THE seventh annual meeting of the Society of Rheology will be held in New York City at the Bell Telephone Laboratories on October 11 and 12 Special features of this meeting will be the two symposia which are being planned on the rheological aspects of rubber and plastics. The committee in charge of the de-

velopment of the plastics symposium are Dr E O Kraemer, Marshallton, Del, and H F Wakefield, Bakelite Corporation The rubber symposium is being developed by Dr Melvin Mooney, U S Rubber Products Company, and J H Dillon Akron, Ohio In addition, a general symposium on rheology is being developed by Dr E C Bingham, Lafayette College and Dr A Nadai, of the Westinghouse Electric and Manufacturing Company Authors having papers which they wish to present at this time are invited to address the specified committees

FINAL sessions of the tenth annual meeting of the Hawaiian Academy of Science were held on the evenings of May 16 and 17 at the University of Hawaii in Honolulu Previous sessions for the presentation of papers had been held on October 24 and 25 The annual dinner was held on May 18 at the Pacific Club, followed by an address on Hawaiian birds by the retiring president, Edwin H Bryan, Jr, curator of Collections of the Bishop Museum The following officers were elected for the year 1935–1936 *President,* Chester K Wentworth, geologic engineer, Board of Water Supply, *Vice president,* Harold A Wadsworth, soil physicist, School of Tropical Agriculture, University of Hawaii, *Secretary treasurer,* Beatrice H Krauss, assistant plant physiologist, Experiment Station, Pineapple Producers' Cooperative Association, *Council,* in addition to officers E H Bryan, Jr, past president, *ex officio,* E L Caum, assistant botanist Experiment Station, Hawaiian Sugar Planters' Association, 1935–1937 Walter Carter, entomologist, Experiment Station, Pineapple Producers' Cooperative Association

ACCORDING to a United Press dispatch, three hundred foreign astronomers are expected at Paris between July 9 and 17 to attend the biennial congress of the International Astronomical Union Presiding over the sessions of the congress will be Professor Frank Schlesinger, director since 1920 of the Yale University Observatory He also heads the executive committee, which draws up the agenda Count de la Baume Pluvinel, who is president of the French National Committee of Astronomy, is arranging for the practical aspects of the congress He is aided by Jules Baillaud, astronomer of the Paris Observatory Thirty nations are to be represented, as was the case in 1932, when the congress was held at Harvard University

THE Division of Medical Sciences of the National Research Council will hold a special meeting in November, 1935, for the consideration of applications for grants in aid in this field Applications to be considered at this meeting must be on file with the Secretary of the Committee on Grants in Aid, Dr Clarence J West, not later than October 1, 1935 Applications received after October 1 and prior to February 15, 1936, will be acted upon at the next regular meeting of the committee in March 1936

E J BUFFINGTON, Chicago steel manufacturer, has given $100 000 as an endowment to Vanderbilt University Half of the endowment is to be used as a general fund and the other half is to endow a chair in the school of religion to be named the Drucilla Moore Buffington chair in memory of his late wife

STANFORD UNIVERSITY has received a gift of $1,000 from the widow of James Perrin Smith, to be used for the maintenance and improvement of his library on the subject of fossil Cephalopoda. The library itself was presented by Mrs Smith to the library of the university soon after the death of Dr Smith in 1931

JULIAN W LOW, of the department of geology of the University of Colorado, has recently completed a mold for the striking of plaster casts of a relief model of the western half of Boulder County The model is 50 inches by 58 inches in size, with a horizontal scale of two inches to the mile, and a vertical scale of one inch to one thousand feet. It includes the western edge of the Great Plains and all the intervening country to and a little beyond the Continental Divide The foothills ridges, the canyon cutting below the Rocky Mountain peneplain, the peneplain remnants themselves and the glaciation near the Continental Divide are some of the topographic features brought out by this model

DISCUSSION

THE NEW ACTIVE PRINCIPLE(S) OF ERGOT

THE arguments advanced by Dudley and Moir in connection with their recent suggestion[1] that *ergotocin* be recognized as identical with *ergometrine* and called by the latter name embody several misconceptions For two of these the careless wording and erroneous placement of the footnote on p 166 of our earlier publication with Davis, Adair and Rogers in the *American Journal of Obstetrics and Gynecology* (29 155–67, February, 1935) were undoubtedly responsible This footnote was intended to announce that Eli Lilly and Company could supply commercial quantities of the pure, active principle, ergotocin—not "an impure preparation," as assumed by Dudley and Moir Indeed, at the time the announcemnt actually appeared the company had been preparing the pure principle

[1] SCIENCE, 81 2110, 559, June 7, 1935

for a period exceeding two months and had accumulated records of tests on over 200 human patients Since Eli Lilly and Company was actually preparing pure ergotocin it might justifiably have continued to apply that name to its commercial product Actually, however, the latter has been given the trade name, "Ergotrate"

The question as to whether or not ergotocin is an "alkaloid" seems to us to be essentially meaningless, since there are no definite chemical criteria by which a substance may be characterized as alkaloidal or non alkaloidal In the earlier paper already cited we called attention to the loose usage of the term 'alkaloid," and made it clear that our own use of the term "non alkaloidal" was intended merely as exclusive of the previously known ergot 'alkaloids rather than as chemically descriptive

It is possible, though not altogether obvious that the principle responsible for the physiological activity of ergometrine is identical with ergotocin It is however, obvious that ergometrine, as described by Dudley and Moir, is not identical with ergotocin Our own analyses of pure ergotocin and several of its salts indicate the empirical formula $C_{21}H_{27}N_3O_3$ (C, 68 41 per cent) (For details, as well as for a discussion of the cleavage products of ergotocin, see the June number of the *Journal* of the American Chemical Society) Dudley and Moir have announced that ergometrine has a carbon content of 71 46 per cent The discrepancy would seem great enough to survive any 'slight modifications" necessitated by "more drastic purification" of an essentially pure substance The physiological properties attributed to ergotocin and to ergometrine are similar but evidently differ in degree The oral dose of ergometrine recommended by Dudley and Moir for human patients is 0 5–1 0 mg, ergotocin is uniformly effective in oral doses of 0 25–0 30 mg On the whole, the assumption of identity of the active principles appears premature, moreover, that assumption would seem to lead inevitably to the conclusion that ergometrine is impure or partially inactivated ergotocin

The implication that the chemical investigation of ergot by the present authors was suggested or inspired by Dr Moir's American addresses seems to us irrelevant to the issue raised As a matter of strict historical fact, however, our interest in ergot had quite another origin Neither of us had the pleasure of hearing Dr Moir during his American visit, nor did we, indeed, hear of him until after we had succeeded in separating ergotocin from the "known ergot alkaloids" late in 1923

M S KHARASCH
R R LEGAULT

THE UNIVERSITY OF CHICAGO

THIOBARBITURATES

THE report of the hypnotic action of a series of barbituric acid derivatives by Fischer and von Mering[1] in 1903 led to the introduction of barbituric acid compounds into medical practice Hundreds of substituted barbituric acids and their soluble salts, alone and in various combinations have been prepared since then in the unceasing search for better products Some of these compounds have been found to possess valuable therapeutic properties and their use is rapidly increasing

Barbiturates may be prepared by condensing urea (or a substituted urea) with derivatives of malonic ester In a similar way we have prepared a series of thiobarbiturates, using thiourea (or a substituted thiourea), instead of urea Only a few thiobarbiturates have been previously reported and these have been used merely as intermediates in the preparation of barbituric acid compounds

There is almost complete lack of pharmacological, clinical and toxicological information in the literature on thiobarbiturates This may be due to the findings of Fischer and von Mering that the administration of 120 mg per kilo of the sulfur analogue of barbital to a dog produced deep sleep, followed by death This finding was broadcast by Fraenkel[2] who deduced therefrom that the presence of sulfur imparts to diethylthiobarbituric acid a pronounced toxic character

The authors have made and studied a number of thiobarbiturates, finding that they show promise as sedatives They produce quiet, natural sleep and are free from side actions and from the after effects observed following the use of their oxygen analogues This work is being continued and will be reported in detail elsewhere

ELLIS MILLER
JAMES C MUNCH
FRANK S CROSSLEY

SHARP AND DOHME
PHILADELPHIA, PA

THE USE OF THE TERM POCONO

IN a recent article George H Chadwick asks "What is Pocono?",[1] a question which has of late been troubling some stratigraphers in Pennsylvania From Mr Chadwick's article it appears that the original definition meant to include certain beds found under-

[1] E Fischer and J von Mering, Therap d Gegenw, 101 97, 1903

[2] S Fraenkel, "Die Arzneimittel synthese," 6th ed., 1927, p 510

[1] G H Chadwick, *Am. Jour Sci* 5th ser, 29 133–143, 1935

lying the Pocono Plateau of eastern Pennsylvania. These beds, Mr Chadwick has clearly demonstrated by both text and figure, may be of late Devonian rather than early Mississippian age, a perfectly reasonable belief in the light of recent changes in the interpretation of the Devonian of eastern New York and Pennsylvania Therefore, the use of the term Pocono formation for these beds is inapplicable if it is also to include early Mississippian strata in other parts of Pennsylvania But, paradoxically, the first published use of the term Pocono did not include the so called Pocono of the Pocono Plateau The first clear recognition of the formation, though under a different name, was that of Rogers[2] in his Vespertine or No X formation

> The Vespertine group of strata, the first of the carboniferous formations of the Appalachians, has a very wide distribution in Pennsylvania, encircling with a sort of outer girdle all the coal fields, both the anthracite and the bituminous ones of the State It undergoes gradual but important changes of type, growing thinner and assuming a finer and finer texture in its materials as it spreads westward Its orographic position is in the mountain ridges and external escarpments of the table lands which enclose or support the coal fields, but, except in the northwestern district of the State, it does not immediately adjoin the conglomerates and sandstones of the coal measures, but is separated from them by a greater or less thickness of the soft, umbral rocks, which fill either an intervening valley or an intermediate space on the coal bearing table lands

From Pennsylvania southward this is essentially the definition of the Pocono as now in use,[3] and is equivalent to that officially recognized by the present Survey[4] The first published use of the term Pocono as a stratigraphic term, in so far as the writers can ascertain,[5] is on the geologic maps of Bradford and Tioga counties, Pennsylvania, published in 1876 These were prepared by Andrew Sherwood under the direction of J P Lesley and accompany Volume G of the Pennsylvania Second Geological Survey The text did not appear until 1878, and, curiously, does not use the term Pocono at all On the map the formation is indicated as "X Pocono Sandstone" lying between "IX Catskill" and "XI Red Shale," but in the text is referred to as "White Catskill" This use accords with the Vespertine of Rogers Not until 1877 did a fuller definition appear In that year both Ashburner[6] and Franklin Platt[7] published definitions They state that the term was proposed by Lesley to supplant Vespertine No X of Rogers. As defined by both it is confined to beds between the "Catskill" and Mauch Chunk. But, Platt wrote

> If No IX be properly called the Catskill Formation because it forms the mass of mountains between the Hudson River and the Delaware, it is perfectly proper that the Gray Sandstone formation, No X, next above it, should be called the Pocono formation, for it forms the mass of the great mountain plateau between the Delaware and Lehigh rivers

Clearly, if Mr Chadwick be correct, this definition is in error, and it is this to which he rightly objects, but the interesting fact remains that this is not the first use of the term From these data it appears that Lesley, perhaps at a staff conference, certainly not later than 1876, proposed the term Pocono to replace Vespertine and intended it to be applied throughout the state wherever Vespertine had been used, whatever his type locality may have been Such was the intent in the first use by Sherwood on two published maps of a region remote from the Pocono Plateau His use is that which many subsequent writers adopted in applying the name Pocono in many parts of Pennsylvania, and it is in this very sense that the term Pocono is now accepted and used stratigraphically in the state and to the south Its application to the plateau between the Delaware and Lehigh rivers, whatever Lesley's original intent, may be wrong and, if so, has been wrongly followed But it seems reasonable that Lesley's original thought, even though he incorrectly dated the beds of the plateau, was to apply the name to the sandstone between the "Catskill" and Mauch Chunk, else the 1876 maps could not have appeared with his approval

There seems no necessity for discontinuing the use of the name Pocono formation for the gray sandstones and conglomerates probably of early Mississippian age which overlie the highest recognized Devonian beds and help support the Allegheny Front, border much of the anthracite fields, produce prominent ridges in central Pennsylvania and appear as more or less flat lying beds in the western parts of the state But, in so doing, we must bear in mind the anomalous situation that the first published application of the term was not to a type locality of that name Here we have a term derived from a type locality which turns out to be probably inappropriate, yet it was originally applied in print, not to that type locality, but to a different place but in the correct, original sense and intent Subsequent stratigraphic studies may even

[2] Henry D Rogers, "The Geology of Pennsylvania," Vol I, 142–143, 1858

[3] D White, *Am. Jour Sci*, 5th ser, 27 265–272, 1934

[4] George H Ashley, Penna Topog and Geol Surv, Bull G–1, 1931

[5] The writers are indebted to Miss M Grace Wilmarth, who has kindly checked the data on the early use of the term, letter of February 15, 1935

[6] C A. Ashburner, *Proc Am. Phil Soc*, 16: 519–560, 1877

[7] F Platt and G W Platt, Penna Second Geol Surv., Vol. H2, 1877

change our ideas about that locality. Evidently, in the case of Pocono, we are forced either to propose an entirely new term, or, and this is by far the more reasonable and least confusing course, accept a name, which, however dubious its origin, is made acceptable by long usage.

GEORGE H. ASHLEY
BRADFORD WILLARD
PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY

DELAYED ACTION OF SELENIUM POISONING OF LIVE STOCK

THE various manifestations of selenium poisoning of live stock by ingesting grains, forages and native range plants carrying toxic and lethal quantities of selenium has received considerable attention during the past few years from chemists and physiologists in the U. S. Department of Agriculture and in a few state experiment stations. Through accumulative data covering many field and experimental cases, it appears that under certain conditions not understood at present an animal may not show any outward sign of poisoning perhaps for several months after grazing upon range plants carrying selenium. When the "break down" occurs, death usually follows in from one to six days. Those that survive seldom regain normalcy. Severe cases show much characteristic pathology.

It is indeed surprising to observe cattle and sheep in an apparently sound and healthy condition suddenly go "off feed," pass bloody urine and rapidly lose weight. To one not familiar with this type of poisoning, it is generally interpreted as due to some immediate physiological disturbance. As a matter of fact, it is now known that such cases may have grazed the causal toxicant months previous to the occurrence of the final acute stage.

O. A. BEATH
UNIVERSITY OF WYOMING

AQUATIC ANIMALS AS COLLECTORS

RECENTLY, when examining some young specimens of the Ocean Sunfish (*Orthagoriscus mola* and *Masturus lanceolatus*), these giants of the ocean, weighing from 400 to 2,000 pounds, I discovered certain young individuals, measuring 2½ inches, among the collections of fishes of the Museum of Comparative Zoology, Cambridge, Mass. They have been found in the stomach of a dolphin.

Another giant fresh-water fish is the Great Caspian Sturgeon (*Huso huso*), which also attains the weight of 2,000 pounds. The young of this species were unknown for a long time until I happened to discover them, as well as those of other sturgeons, in the stomachs of cat-fishes (*Silurus glanis*).

Thus, naturalists are indebted to the voracious dolphin in the ocean and to the voracious cat-fish in fresh waters for collecting the rarest specimens of the young of two giant fishes.

By publishing this short notice I would like to call the attention of my ichthyological colleagues to those facts and urge to lose no opportunity of dissecting the stomachs of voracious aquatic animals with a view to finding other fish which they have swallowed. Those creatures may prove of great assistance to us in collecting very rare specimens.

N. A. BORODIN
MUSEUM OF COMPARATIVE ZOOLOGY
CAMBRIDGE, MASS.

EXTENDED HIBERNATION IN THE TOAD

THE writer believes he has an example of extended hibernation in the common toad, *Bufo americanus*.[1] In 1908, the W. E. Caldwell Company, Louisville, Kentucky, constructed a structural steel plant over some filled swampy land. On November 1, 1934, twenty-six years later, while digging in one of the buildings for the placing of a new furnace, two toads were exhumed. The first was about four and one-half feet and the second nearly eight feet below the clay floor of the building. An examination of the walls of the pit showed the fill to be of yellow clay with an occasional small air space, none over one-half inch in diameter. There was no indication of any type of passage-way by which the toads may have entered. The closest distance from the pit to the wall of the building was twenty-five feet. The foundation of the building is fourteen inches thick and extends four and one-half feet below the clay floor of the building.

The workmen placed the first toad on the edge of the pit, believing it to be dead, but in a short time it hopped away. The second toad was saved. It was so thin that little remained but skin and bones. It revived to such an extent that it was able to hop and to turn over when placed on its back. When it was brought into the warm laboratory, it died within two hours.

P. A. DAVIES
UNIVERSITY OF LOUISVILLE

ECOLOGICAL NOTE

OUR *Felis domestica* recently committed a nuisance on a small rug. He then removed from the bookcase a Guidebook to Boston and a Guide to the Wild Flowers of Pennsylvania, with which he carefully covered his misdeed.

E. A. VUILLEUMIER
DICKINSON COLLEGE

[1] The writer is indebted to Mr. Walter E. Caldwell for calling his attention to the hibernation and for permission to examine the pit and to take the necessary measurements.

REPORTS

GRANTS FOR RESEARCH OF THE GEOLOGICAL SOCIETY OF AMERICA

THE following twenty four grants have been approved recently by the Geological Society of America, in support of special research projects

Robert T Hill, Dallas, Texas, $1,200 to cover expenses connected with research in the history of geologic investigation in the Southwest

F M Anderson, Berkeley, Calif, $300, to cover cost of illustrations connected with study of the stratigraphy and faunas of the Cretaceous deposits of northern and central California and Oregon

Christina Lochman, Chicago, $1,000, to cover field, laboratory and office expenses for completion of memoir on the Upper Cambrian faunas of Montana, Wyoming and South Dakota

R S Bassler, Washington, D C, $600, for photographic assistance in preparation of paper on the stony bryozoa (Trepostomata)

Richard Foster Flint, New Haven, $475, to cover field and laboratory expenses connected with study of the Pleistocene drift borders across the Idaho Washington line to the Cascade Mountains

Charles A Anderson, Berkeley, Calif, $350, for rock analyses for study of the volcanic history of the Clear Lake area north of San Francisco

John T Rouse, Clinton, N Y, $425, for traveling and field expenses, study of the structure and tectonic history of the Absaroka volcanic area, Wyoming

Charles H Behre, Jr, Evanston, Ill, $1,000, to cover traveling, field and laboratory expenses connected with an examination of the geologic setting of the great depression of the South Park, Colorado

Duncan Stewart, Jr, Northfield, Minn, $100, for thin sections in study of duplicate rock specimens from the Antarctic Archipelago and the South Orkney Islands

James H Gardner, Tulsa, Okla, and Donald C Barton, Houston, Texas, $550, for expenses connected with the running of precision levels on salt domes in Texas and Louisiana, in order to determine possible differences in elevation caused by movement in the salt domes during coming years

H W McGerrigle, Hanover, N H, $500, for office expenses connected with study of the succession of faunas in the Philipsburg group of southern Quebec and northern Vermont

H R Wanless, Urbana, Ill, $600, for field and miscellaneous expenses connected with determination of the correlation of coal seams and other strata of the Pennsylvanian between the eastern interior coal field and the Appalachian coal field

F M Carpenter, Cambridge, Mass, $125, for expenses connected with the collecting of Permian fossil insects in Dickerson County, Kansas

Julia Gardner, Washington, D C, $700, for traveling and office expenses and assistance connected with study of the Tertiary faunas of northern Mexico and their relation to the faunas of the eastern Gulf Province (This investigation was supported in 1933 and 1934)

Norman D Newell, Lawrence, Kansas, $142, for traveling and field expenses for investigation of a fauna occurring in the Woodward formation in the Upper Cimarron Group

Joseph A Cushman, Sharon, Mass, $1,500, for clerical and other assistance in completion of monograph of the foraminiferal family *Nonionidae*

Lewis B Kellum, Ann Arbor, $2,000, to cover field expenses in connection with cooperative studies of the geologic history and structural development along the ancient continental margin in Coahuila and adjacent states (This investigation was supported in 1933 and 1934)

Marcellus H Stow, Lexington, Va, $288, for traveling and field expenses and photographic supplies, connected with investigation of the Paleocene and Eocene sedimentation and stratigraphy in the western part of the Bighorn Basin

W H Twenhofel, Madison, Wis, and Frank F Grout, Minneapolis, Minn, $1,000, for field and laboratory expenses of study of the accessory minerals in igneous rocks and pre Cambrian sediments in the Lake Superior region Half of this amount is to be expended by workers at the University of Minnesota and half by workers at the University of Wisconsin (This investigation was supported in 1934)

Walter H Bucher, Cincinnati, $800, to cover traveling and field expenses and assistance in connection with investigation of the Heart Mountain overthrust in Wyoming

Henry S Sharp, New York, $400, to cover traveling and field expenses connected with study of the origin, age, correlation and relationship to erosional surfaces in the adjacent plains, of the "Sub summit" peneplain of the Beartooth Mountains

Arthur D Howard, New York, $344, to cover traveling and field expenses connected with study of the history of the Grand Canyon of the Yellowstone

Frank J Wright Granville, Ohio, $475, for traveling and field expenses in connection with correlation of the erosion surfaces of the Bighorn Basin

B L Miller and Maurice D Ewing, Bethlehem, Pa, $2 000, for field expenses, equipment, assistance and supplies connected with seismic work on the eastern Continental Shelf

One hundred and thirty three research grants made by the Geological Society since December, 1932, amounted approximately to $125,000

GRANTS FOR RESEARCH OF THE AMERICAN PHILOSOPHICAL SOCIETY

GRANTS to support special research projects by the American Philosophical Society from April, 1934, to March, 1935, were announced at the annual meeting. The value of the awards ranges from $50 to $6,000 Recipients of the grants and their projects are

HELLMUT DE TERRA, Peabody Museum of Natural History, Yale University, to enable him to study the geological background of early man in Northern India through

the use of concerted methods of geology, paleontology and prehistory, and to search for early hominids and fossil anthropoid apes to advance our knowledge of man's evolution and his earliest cultures

RALPH E CLELAND, Goucher College, Baltimore, in support of his work for a cooperative cytogenetic and taxonomic attack upon the phylogeny and systematics of Oenothera (evening primrose), with special reference to the sub genus onagra

F K RICHTMYER, Cornell University, to enable him to continue his work on the determination of the widths, shapes and relative intensities of the lines in the x ray spectra of the several elements, and the use of these data to compute the distribution of energy in the excited states of atoms

FARRINGTON DANIELS and B M DUGGAR, University of Wisconsin, in support of a fundamental research in photo synthesis, concerned with a determination of the quantum efficiency in this process when employing monochromatic light in different regions of the spectrum using algae as test material

K LARK HOROVITZ, Purdue University, in support of his investigation on the intensity of electron scattering by means of homeo polar compounds

HARRY SHULTZ VANDIVER, University of Texas to enable him to continue his work on the computation and investigation of the properties of Bernoulli numbers with special application to Fermat's last theorem, perhaps the best known of all unsolved mathematical problems

FRANK G DUNNINGTON, California Institute of Technology, to enable him to continue his work on a precision determination of the specific charge of a free electron by a new deflection method

N T BOBROVNIKOFF, of the Perkins Observatory, for investigations of stellar spectra, mostly in the red and infra red, with a special attention to the band spectra

JUDSON DALAND, Philadelphia Institute for Medical Research, in support of work on the biological effects of thymus extract (Hanson)—the accruing acceleration in the rate of growth and development in successive generations, from the extract of thymus

FRANK C JORDAN, for the Allegheny Observatory, to cover expenses in connection with the work on the measurement of plates and computations for the determination of stellar parallaxes

C E MENDENHALL and G BREIT, University of Wisconsin, in support of the experiments on nuclear disintegration and scattering with protons and deutons accelerated by about 300 K V

ALEXANDER PETRUNKEVITCH, Yale University, to enable him to continue his work on the physiology of digestion and digestive enzymes in spiders

CHARLES E ALLEN, University of Wisconsin, for the determination of the chromosome complements of heteroploid clones of sphaerocarpos

HENRY A PILSBRY, Academy of Natural Sciences, Philadelphia, to enable him to collect and make field studies of mollusks of Sonora and Sinaloa, Northwestern Mexico, with the object of determining the relation of the Sonoran fauna of our Southwest to the neotropical fauna of Mexico

FRANCIS W PENNELL Academy of Natural Sciences, Philadelphia, to enable him to collect and make field studies of plants, especially of the family scrophulariacea, in Sonora and Sinaloa, Northwestern Mexico, considering the composition and distribution of the flora and its relation to that of the Southwestern United States and Southern Mexico

EDGAR F HOWARD University Museum, University of Pennsylvania, to investigate the problem of man's antiquity in America, with particular reference to a study of possible routes of migrations from Asia

FREDERICA DE LAGUNA, University Museum, University of Pennsylvania, to make an archeological investigation of the lower Yukon Valley from Koyukuk to Holy Cross

CHARLES P OLIVIER Flower Observatory, University of Pennsylvania for the study of meteor trains, including their heights durations, drifts spectra, constitution and other physical characteristics

ALEXANDER BIDDLE, for the National Economy League, for (1) the state wide gathering of facts on the 5,635 tax levying units in Pennsylvania by the Pennsylvania Economic Council, (2) the study of Philadelphia government by the Philadelphia committee

HARLAN T STETSON, Harvard University, for investigation of cosmic terrestrial relations

SPROUL OBSERVATORY, Swarthmore College, to determine the magnitude of stars utilizing the energy received from them in wave lengths in the red and infra red parts of the spectrum

PERCY BUCHANAN Naka Ku Nagoya, Japan, for the investigation of the early linguistic origins of Japanese

CHARLES A KOFOID, University of California, for a morphological and physiological investigation of the neuromotor system of the ciliate protozoa in all the major types of ciliates, with a view to defining the structure and function of such system

REAR ADMIRAL JOHN D NARES, for the International Hydrographic Bureau, Monte Carlo, for the preparation of base charts

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE PHOTOGRAPHIC RECORDING KYMOGRAPH[1]

WE wish to describe a photographic recording device which we have found so convenient and so satisfactory that we believe it may prove useful in other laboratories where kymographs are employed Many tracings, ordinarily written on smoked drums, may advantageously be recorded with this apparatus, and the friction of lever points on paper and the laborious adjustment of these points to the writing surface may thereby be eliminated Furthermore, this direct and practically undistorted recording of changes in the level of a liquid in a manometer provides an accurate

[1] Submitted for publication April 9, 1935.

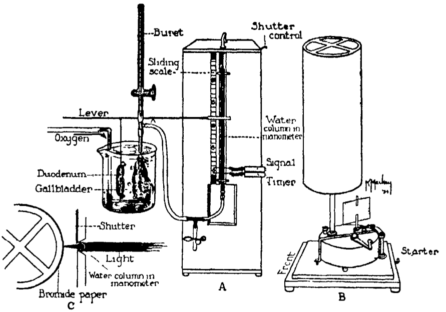

FIG. 1. The recording device in use. The significance of the initials is given in the text.

record of volume and pressure changes in any given system.

As early as 1883, E. A. Schäfer[2] utilized the photographic method to record changes in volume, whereas Baldes[3] and Corbeille, in 1929, utilized the method in recording plethysmograms.

Records were made on photographic bromide paper fastened to the drum of a "Harvard" kymograph (Fig. 1, B), which is enclosed in a light-tight box (Fig. 1, A). A vertical slit, 2 mm wide, opened or closed by means of a shutter, was made along the front elevation of this box and a water manometer was placed immediately in front of this slit. The source of light was an ordinary projection lamp, which was placed about 30 feet (9 m) from the recorder, so that the light rays were directed against the manometer. To secure optimal results it is essential that the effective light rays, the long axis of the manometer, the midline of the slit in the box and the axis of the revolving drum should be properly aligned (Fig. 1, C). The manometer, containing a liquid, functioned as a lens, so that light passing through the liquid was focused on the light-sensitive paper fixed to the revolving drum of the kymograph. It is apparent that changes in the level of the liquid were recorded on the paper by the marked contrast between the intensity of exposure above and below the level of the meniscus. Likewise, any movements of levers, time signals or markers may be recorded simultaneously with the changes in the level of the meniscus.

A manometer tube, of the type employed clinically for measuring spinal fluid pressures, was found convenient in our experiments. These tubes are of particular value for records of this sort, since they are accurately calibrated and the photograph of these lines on the record is of value in computing changes in the level of the meniscus. These tubes contain 0.02 cc of fluid per centimeter of length and thus permit the recording of changes in pressure without appreciable changes in the volume. A satisfactory type of contrast bromide paper, 70 feet (21.3 m) in length and either 6 or 12 inches (15.2 or 30.4 cm in width), is obtainable in rolls. A developer which gives the maximum of contrast must be used.

Reproductions of records made with the apparatus that has been described above accompany an article by Deissler and Higgins, entitled "The Extrahepatic Biliary Tract during Anaphylaxis"; this article has been accepted by *The American Journal of Physiology*.

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[2] E. A. Schäfer, *Jour. Physiol.*, 5: 127–129, 1883–1884.

[3] E. J. Baldes and Catherine Corbeille, *Proc. Soc. Exper. Biol. and Med.*, 26: 711–715, May, 1929.

A MICRO-METHOD FOR DETERMINING THE UTILIZATION OF CARBOHYDRATES AND POLYHYDRIC ALCOHOLS BY MICROORGANISMS

IT is sometimes desirable to know whether a single colony of bacteria, without further sub-culture, is composed of organisms capable of utilizing one or more particular carbohydrates. This can be easily and quickly accomplished by the following micro-technique.

The colony is removed from the surface of the agar by a platinum inoculating loop and mixed with several loopfuls of a M/750 phosphate buffer at a pH of 7.3, containing 0.04 per cent phenol red in a depression slide. By means of the loop (or a smaller one, if several substrates are to be studied) droplets are removed from the depression to the flat surface of the slide. A loopful of distilled water is mixed with one droplet as a control, and a loopful of a 1.0 per cent distilled water solution of a given carbohydrate is mixed with another droplet. The suspensions of cells prepared in this manner are then taken up in capillary tubes having an inner diameter of 0.35 mm and observed for change in color of the indicator. If the substrate is oxidized the solution will become acid, due either to the liberation of fixed acid or to an excess CO_2 production, while the control will remain unchanged, since the CO_2 production is too low to affect the buffer. In the case of a 2 mm colony of *Escherichia coli* treated in this manner, the change from orange red to yellow occurred within fifteen minutes, with glucose as substrate, while the control underwent no change over a period of several days in the incubator.

The same method has been fully tested on a slightly larger scale, using capillary tubes of 1 to 2 mm inner diameter, with the washed cells of luminous bacteria (*Vibrio phosphorescens* and *Achromobacter fischeri*) as well as *Escherichia coli* and yeast. Thirty substrates, including pentoses, hexoses, heptoses, polysaccharides and two-, three- and six-carbon polyhydric alcohols, have been tested with each of the above species. The method works equally well in small test tubes, 10 × 75 mm, which insure partial anaerobiosis by virtue of the fact that oxygen diffuses in sufficiently rapidly only for the cells in the uppermost layer of the suspension to remain aerobic. Washing the cells with the aid of the centrifuge is desirable in order to get the results of the "resting" metabolism, uncomplicated and unobscured by extensive products and processes of vigorous growth. Except with the most slowly fermented substrates, such as dulcitol, the results are obtained within a few minutes, or at most a few hours. The rate depends, of course, on the concentration of cells, the concentration of buffer, and the rate and products of decomposition of the substrate, but in general, satisfactory results are obtained when washed cells from a heavily inoculated 18 hour nutrient agar Petri plate are resuspended in 15 to 20 cc of M/150 buffer. The suspension is aerated by a stream of air for about fifteen minutes, and 1 cc portions diluted with an equal volume of substrate solution in small test tubes.

This method has given results entirely consistent with those found in the case of the aerobic oxidation of substrates by the 'resting' cells of luminous bacteria in Warburg respirometers, except for glycerine, which is easily oxidized aerobically but apparently not in a limited oxygen supply. While only the oxidations occurring at an initial pH of 7.3 have been studied, it should be possible with appropriate indicators, to study different pH ranges.

Gas formation could be detected in the case of yeast, by large bubbles in the capillaries, but not very well with *Escherichia coli*. With the latter gas formation could be detected by means of very small glass tubes, sealed at one end and filled by a micro pipette, and inverted in the small test tube containing the suspension. In this case, however, gas was not formed from certain substrates apparently because acid accumulated so fast that the cells were precipitated in a few minutes. The accumulation of gas required incubation over night. No further change occurred after several days, and the controls never indicated any decided acid production or gave any indication of gas formation.

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SPECIAL ARTICLES

THE CULTURE OF WHOLE ORGANS

THE method to be described consists of the transplantation of an organ or of any part of the body into a sterile chamber, and of its artificial feeding with a nutrient fluid through the arteries. It is not in any way a substitute for the method of tissue culture. Its techniques, as well as its purposes, are quite different. As is well known, tissues and blood cells grow like bacteria in flasks containing appropriate media. The techniques for the cultivation of tissues are somewhat analogous to bacteriological techniques, although far more delicate. But it is through the employment of complex mechanical and surgical procedures that organs are enabled to live isolated from the body. Tissue culture deals with cells as units of bodily structures, the new method, with cellular societies as organic wholes. Its ultimate purposes are the manufacture *in vitro* of the secretions of endocrine glands, the isolation of the substances essential to the growth, differentiation and functional activity of those glands, the discovery of the laws of the association of organs, the production *in vitro* and the treatment of organic and arterial diseases, etc.

The idea of maintaining alive a portion of the body in order to study its functions is not new. In 1812, the physiologist Le Gallois[1] wrote that, "if one could sub-

stitute for the heart a kind of injection of arterial blood, either natural or artificially made, one would succeed easily in maintaining alive indefinitely any part of the body whatsoever" But Le Gallois did not attempt to supply organs with such artificial circulation The first perfusion apparatus probably originated from Ludwig's laboratory In 1866, de Cyon kept the heart of a frog beating for 48 hours[2] Later, he demonstrated by a similar technique that a perfused liver still manufactures urea. Brown Séquard observed the reestablishment of certain cerebral functions by circulating blood through the vessels of a head separated from its body[3] The later history of the perfusion of organs is well known[4] But the best and more recently constructed apparatus have never been capable of maintaining a gland in a condition of survival for more than a few hours Even during this short time the organ was being rapidly invaded by bacteria It is only recently that surgical and mechanical procedures became sufficiently perfected to allow organs to be cultivated *in vitro* With the study of the transplantation of organs and their blood vessels,[5] techniques were developed for handling the arteries, washing the organ free from blood without injuring the cells, and preventing emboli During the last war, antiseptic procedures that permit complete protection of tissues from bacteria in the course of surgical operations came into being in the laboratories supported by the Rockefeller Institute in Compiègne But there was no apparatus capable of playing the rôle of heart and lungs and of keeping an organ free from infection indefinitely In this laboratory, a long search has been made for the proper apparatus An ingenious magnetic pump was constructed some years ago[6] Later, a much simpler apparatus was designed,[7] which maintained an artificial circulation through a segment of artery for a month without infection Still other kinds of apparatus, based on different principles, were built in the following years Finally, in 1935, a model was developed that has for the first time permitted an entire organ to live outside of the body[8] The purpose of the present article is merely to show how, after 123 years, the conception of Le Gallois has been realized

The organs are removed from an animal that has just been killed by bleeding under anesthesia Adult fowls or cats are generally used An ovary, a suprarenal, or a thyroid gland is removed by a procedure similar to that employed in the transplantation in mass of organs[9] That is, the organ is extirpated, together with its surrounding tissues, arteries, veins, nerves and lymph vessels In the explantation of the ovary, for instance, the Fallopian tube, the ovary and a flap of peritoneum and connective tissue containing the ovarian artery are dissected as far as the aorta and removed During the course of the operation, the abdominal cavity and the organ are constantly protected with gauze pads soaked in Dakin solution In this manner, the operation can be performed successfully in a room that is not dust proof

The culture medium varies in quantity and composition In order that the supply of glucose and bicarbonate may be sufficient for several days, the volume of medium must be about 2,000 times greater than that of the tissues For instance, a cat's thyroid gland, varying in weight from 85 to 110 mgs, demands about 230 cc of nutrient fluid The apparatus may be operated with from 200 to 900 cc of medium This medium consists of blood serum or of more or less growth activating solutions prepared by L E Baker Such solutions contain protein split products, hemin, cysteine, insulin, thyroxine, glutathione, vitamin A, ascorbic acid, blood serum, etc A small amount of phenol red is indispensable as an indicator of the metabolic activity of the organ, as well as of the occurrence of bacterial infection In some experiments, hemoglobin is added to the fluid The gaseous medium consists of 40 per cent oxygen, and from 3 to 4 per cent carbon dioxide, the remaining part being nitrogen

The organ is introduced into the culture chamber while being protected by a sheet of Cellophane, and the artery is connected with the cannula of the apparatus Then the chamber is closed by a rubber stopper and sealed with a cellulose acetate cement The apparatus maintains a sterile pulsating circulation through the organ for a length of time limited only by the condition of the organ and the perfusion fluid The pulsation rate and both maximum and minimum pulsation pressures are adjustable The perfusion fluid is kept well aerated and in contact with gas of controlled composition Pulsation pressures are practically unaffected by changes in the rate of flow through the organ Filming and evaporation are prevented Both the organ and perfusion fluid may be observed at all times The apparatus is kept in an incubator at a temperature of 37–38° C The circulation is started about 1 hour after the death of the animal The number of pulsations, in most of the experiments, has been about 60 per minute, the systolic pressure, 120

[1] C J J Le Gallois, "Expériences sur le principe de la vie," Paris, 1812

[2] E De Cyon, *Arch ges Physiol* (Pflüger's), 77 215, 1899, *Compt rend Soc Biol*, 52 372, 1900

[3] E Brown Séquard, *Jour Physiol de l'Homme et des Animaux*, 1 95, 353, 1858

[4] A E Belt, H P Smith and G H Whipple, *Am Jour Physiol*, 52 101, 1920

[5] A Carrel, *Jour Exp Med*, 10 98, 1908

[6] H Rosenberger, SCIENCE, 71 463, 1930

[7] C A Lindbergh, SCIENCE, 73 566, 1931

[8] C A Lindbergh, *Jour Exp Med*, 1935, in press

[9] A Carrel, *loc cit*

mm Hg, and the diastolic pressure, 60 mm Hg Some fluid may leak and spurt from small blood vessels without markedly lowering the pressure The progressive decrease of the pH of the medium is detected by comparing the color of the fluid feed tube of the apparatus with that of a set of standard tubes

Twenty-six experiments have been performed since the last model of the apparatus was made The organs were thyroid, ovary, suprarenal, spleen, heart and kidney Some organs were transferred several times from apparatus to apparatus Infection occurred twice only This accident took place in spleens that obviously were contaminated before removal from the abdomen Thyroid glands were kept more than 20 days with pulsating arteries and active circulation They could have remained in the apparatus much longer No emboli and no important hemorrhages were observed. The lowering of the pH of the medium occurred more or less rapidly according to its composition In diluted blood serum, cat's thyroid glands consumed only about 7 mg of glucose per 24 hours When they were perfused with a growth promoting fluid, the glucose consumption increased more than three times

Changes in form and volume took place in the organs from day to day Thyroid glands perfused with diluted serum were observed to decrease in size progressively On the contrary, ovaries or thyroids perfused with a growth promoting medium modified their form and grew rapidly In 5 days, the weight of an ovary increased from about 90 to 284 mg Simultaneously, three corpora lutea developed At the end of the experiments, that is, after from 5 to 21 days, small fragments taken from the organs and cultivated in flasks engendered active colonies of epithelial cells and fibroblasts The epithelium of an adult thyroid was found to have recuperated its fetal activity after being perfused for a few days with a growth-activating fluid The sections showed an almost normal structure of fragments of the thyroid, even when the gland had been roughly treated and perfused with dilute serum for a long period of time, when the pH had been lowered to 7 2 for several days or when the circulation had markedly decreased The presence of colloid was observed in some follicles If perfused with a growth promoting fluid, the structure of the gland was altered The colloid substance disappeared The epithelial cells proliferated within and also outside the follicles In ovaries treated in the same manner, growth was also accompanied by disorganization There was a luxuriant and disordered proliferation of the stroma and of the epithelial cells Obviously, a large amount of new tissue had been manufactured by the organ The fluids that had circulated through the apparatus were tested for modifications induced by the organs In every case, the thyroid glands were found to have set free substances that stimulated the proliferation of leucocytes more or less markedly

The structural and functional changes undergone by the organs during their life *in vitro* are complex. They obviously depend on the chemical composition and the physicochemical and physical conditions of the perfusing fluid They will be discussed in subsequent articles From the present experiments, it must merely be concluded that an entire organ, such as an ovary, has been maintained alive *in vitro* It not only survived, but increased in size and in weight This increase was due to the appearance of new cells and tissues It is, therefore, probable that this method provides important uses in physiological chemistry, physiology and pathology

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ANALYSIS OF ROTATORY DISPERSION OF CHEMICALLY ANALOGOUS SUBSTANCES

IN view of an article by W Kuhn and H Biller announced to appear in *Z phys Chem*, "Drehungsbeitrag chromophorer Gruppen bei analog gebauten Verbindungen," we wish to report briefly the results of similar work which has been in progress in our laboratory in course of several years

In Table I are given the directions of the partial rotations of the individual absorption regions in substances of the general type of

$$H-\overset{\displaystyle R_1}{\underset{\displaystyle R_2}{\overset{|}{\underset{|}{C}}}}-(CH_2)_n-X$$

(R_1 and R_2 being alkyl groups, X a functional group, $C\!\!\begin{smallmatrix}\diagup H\\ \diagdown\!\!\!\diagdown O\end{smallmatrix}$, N_3, SH, Halogen n = 0 or an integer) All substances in which X = N_3, NH_2 and $C\!\!\begin{smallmatrix}\diagup H\\ \diagdown\!\!\!\diagdown O\end{smallmatrix}$ are configurationally correlated, when X = SH or Halogen, all substances in which n = an integer are likewise configurationally correlated by direct chemical methods and *those in which n = 0 are not so correlated*

The most significant facts appearing from the data given in Table I are

(1) The band of group X with the lowest frequency in some instances furnishes the principal partial rotation determining the direction of the optical rotation of the substance in the visible

In other substances the partial contribution of the absorption region of low frequency depends upon the

TABLE I

	Compounds	Rotation in the visible	First absorption band in A.	Contribution of first band.	Second absorption region	Contribution of second absorption region	Sum of all other contributions
	Aldehydes						
I.	2-methylbutanal-1	–	2960	–			?
	3-methylpentanal-1	+	2940	+			–
	4-methylhexanal-1	–	2940	+			–
	Azides						
II.	2-azidooctane	+	2880	inactive	from 2200	+	?
	1-azido-2-methylbutane	–	2880	"	"	–	+
	1-azido-2-methylnonane	+	2880	"	"	–	+
	1-azido-3-methylpentane	–	2880	"	"	–	+
	Amino—						
III.	2-aminooctane	+	ca 2300	–			+
	2-aminooctane hydrochloride	–	ca 2100	–			
	1-amino-2-methylbutane	+	ca 2300	+			–
	Thio—						
IV.	2-thiobutane	–	2300	inactive	from 2100	–	?
	2-thioheptane	–	2300	"	"	–	?
	1 thio 2-methylbutane	–	2300	"	"	+	–
	*Iodo—						
V.	2-iodobutane	+	2630	+	from 2000	+	?
	2-iodooctane	+	2630	+	"	+	?
	1-iodo-2-methylbutane	–	2570	?	"	+	–
	1-iodo-2-methylheptane	–	2570	?	"	+	–
	1-iodo-2-methylnonane	–	2570	?	"	+	–
	1-iodo-3-methylhexane	–	2570	–	"	–	?
	1-iodo-4-methylheptane	–	2570	–	"	–	?
	1-bromo-2-methylbutane	–	2000	+		–	
	Isopropyl Derivatives						
VI.	2-iodo-3-methylbutane	+	2670	+	from 2000	–	
	4 iodo-5-methylhexane	–	2670	negligible	"	–	
	1-iodo-2, 3-dimethylbutane	–	2570	"	"	–	
	1-iodo-3, 4-dimethylpentane	–	2570	– (slightly)	"	–	
	1-azido-2, 3-dimethylbutane	–	2880	inactive	from 2200	–	+

* Most of the normal halides were prepared by Mr. R. E. Marker.
The detailed results on these substances will be published under joint authorship.

values of n, and in one case depends upon the value of R_1.

(2) In those groups of substances in which all members are configurationally correlated (I, II, III) the direction of the predominating partial rotation of X changes sign when n passes from the value 0 to that of an integer.

The case of the halides of the normal series needs special discussion. In the secondary halides, both the first and the second absorption regions of the halogen atom seem to be active and to furnish the major part of the rotation in the visible region. In the iodides having n = 1, the principal contribution in the visible apparently is furnished by the third absorption region of the iodine atom, the first and second being of opposite sign and of small numerical value. In the bromide the rotation in the visible seems to be furnished principally by the second absorption region of the bromine atom, the first being of opposite sign and of small value.

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SCIENCE

VOL. 81 FRIDAY, JUNE 28, 1935 No. 2113

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6 00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D C.

THE THERMIONIC VALVE IN SCIENTIFIC RESEARCH[1]

By Sir AMBROSE FLEMING

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THE thermionic valve, which as a technical invention has made possible the great achievements of telephonic broadcasting and television, arose out of scientific research intended to elucidate certain observed phenomena in connection with the working of incandescent electric lamps in 1882 and 1883. It has also provided in itself a new and valuable instrument of research for physical investigation. The initial steps were taken in this invention when the writer as scientific adviser of the original Edison Electric Light Company of London began to study the projection of carbon atoms from the carbon filament of the then used Edison carbonized bamboo filament electric lamps, which, together with the carbonized cotton thread incandescent lamps of Swan, provided the first practical domestic electric lighting system for general use It was soon found that these lamps had a black deposit made on the interior of the glass bulb in course of time which was fairly uniform and was doubtless due to an evaporation of the carbon, which substance like iodine and camphor and some others passes from the solid state to the gaseous without any intermediate liquid state.

On the other hand, in certain cases in which a line of no carbon deposit appeared on the bulb in the plane of the hairpin-shaped carbon filament, it was evident that the projection of carbon particles had taken place from one particular overheated point on the filament. This projection was due to a process of electric "splut-

[1] Abstract read by Dr. Howard McClenahan, secretary and director of The Franklin Institute, at Medal Day Exercises in the institute when Sir Ambrose was awarded the Franklin Medal.

tering" which was also the cause of a green copper deposit on the bulb in some cases, since in the Edison lamps the ends of the carbon filament were well connected to the platinum leading in wires by an electro-deposit of copper over the clamp This carbon spluttering then clearly took place along straight lines by reason of electric repulsion of carbon ions carrying an electric charge

Edison had noticed in 1883 that when a metal plate carried on a wire was sealed through the bulb of his carbon filament lamp and connected externally to the lamp by a circuit joined to one or other terminal of the filament, an electric current flowed in this circuit if it terminated on the positive terminal of the lamp filament which was heated by a direct voltage but little or no current when the current terminated on the negative terminal of the filament The author of this paper made an extensive investigation of the cause of this effect which Edison had not explained or utilized This was published in 1896 in the Proceedings of the Physical Society of London and in the *Philosophical Magazine* for July, 1896

In this paper an extensive set of experiments was described which proved that certain particles charged with negative electricity were being ejected from the incandescent filament of carbon or from metal wires raised to incandescence in an evacuated bulb It was at first assumed that these carriers were atoms or ions of carbon It was proved that they were material particles of some kind, but it was not until four or five years later that Sir Joseph Thomson showed that they were the particles of ultra atomic size we now call electrons

Amongst the experiments described was one in which a grid formed the positively charged anode plate by which the electrons shot off from the filament were collected

It was then proved in the above-mentioned paper that if a highly evacuated glass bulb had in it one hot carbon and one cold metal electrode the space between had a unilateral electric conductivity and could convey negative electricity from the hot cathode to the cold anode but not in the opposite direction A large variety of experiments supported this conclusion

No additional uses or practical application of this fact was made until after the advent of electromagnetic wave telegraphy, when it became evident that it would be necessary to replace the capricious and easily disturbed coherer by some more certain device as a detector of the feeble high frequency electric currents or voltages induced in the receiving aerials of wireless telegraph apparatus

The writer then made in November, 1904, the type of rectifying electronic valve since associated with his name, which converted these small alternating currents into direct currents which could be detected by galvanometers or telephone receivers and thus made signal-detecting instruments in this system of wireless telegraphy It consisted of a carbon filament vacuum lamp having a metal cylinder round the filament, the said cylinder being carried on a wire sealed through the wall of the glass bulb This Fleming rectifying valve came immediately into extensive use by Marconi's Wireless Telegraph Company in England as a practical wireless detector It preceded by two years the invention of the first crystal rectifying detector of H H C Dunwoody, namely, the carborundum crystal detector

It is frequently stated that the early Fleming valves were merely low vacuum, or as we should now say, soft valves This, however, is quite incorrect In one of the writer's British Specifications it is clearly stated that a high vacuum is to be made in the bulb, and as a matter of fact some of the earliest valves made were exhausted by the use of the beautiful process of Sir James Dewar, in which the high vacuum is made by the absorptive power for gases of cocoanut charcoal cooled with liquid air

In this case the electric current in the valve is wholly conveyed by electrons emitted by the incandescent filament and not by ionization of residual gas atoms in the bulb It was not then a subsequent invention to create what is now called a "hard" valve Some of the earliest experimental thermionic valves were quite hard The writer also showed that by the use of two such rectifying valves both phases of an alternating current could be rectified or converted to direct currents The addition of the "grid" between the "plate" or anode and the incandescent filament which converts the rectifying valve into an amplifying valve was first described by Lee de Forest in his United States patent of 1908, dating, however, under the convention as from January 29, 1907 But the strange thing is that this British patent for an important improvement was allowed to lapse in 1911, whereas it could have been maintained for fourteen years from the date of application in England by payment of fees

When we speak of an electron as "particle," that immediately raises the question, What is this particle made of? And even if we assume the existence of subelectrons, we ask what they are made of, and so on The same for photons often asserted to be "particles" or "quanta" of energy

The new quantum theory suggests to us that we must think of electrons as wave groups in a medium and that may involve that the so-called motion of an electron is not a bodily movement of something retaining a constant individuality but the cessation of some kind of wave in one place and its recreation in another The photon on the other hand may be regarded

simply as a singularity on the wave front of the light, a locality where the amplitude of the light vectors is greater than the average, thus giving, as Sir Joseph Thomson called it, a "speckled" appearance to the wave front. As the wave passes over atoms it is only at these singularities that the energy is great enough to cause a possible elevation of an orbital electron to an orbit of greater potential energy.

We must bear in mind, however, that the mental pictures we are able to form of physical events are in any case only symbols or heiroglyphics and may bear no more resemblance to the actual event or phenomena than the written or printed marks which form what we call a "word" bears to the form of the thing that word denotes.

Our mental pictures are made up necessarily of fragments of past sense impressions, and the more easily or clearly we can build up a mental picture of a physical event the less it is likely to be true to fact. In any case it only suffices for a certain limited time and then has to be thrown on one side. Thus the Thomson mental picture of an atom was superseded by that of Bohr and that of Bohr by that of Schroedinger and that in turn by some yet unimagined conception.

We pass on then to mention some other interesting applications of the thermionic valve in scientific research, and one of these is due to Dr. R. Whiddington, Cavendish professor of physics in the University of Leeds, described in the *Philosophical Magazine* of November, 1920. If in a three electrode thermionic valve or triode, as it is often called, we couple inductively by a transformer the grid and the plate or anode circuits, and if the latter includes a capacity inductance closed circuit of low resistance, then oscillations are set up in this circuit determined by the capacity and inductance.

If a second valve oscillator is set up having a condenser of capacity which is adjustable, we can arrange that the frequency difference of the two sets of oscillations comes within the audible range and creates "beats." These can be amplified by a valve amplifier and made to acuate a loud speaking telephone so that the beats per minute can be easily counted. If then the capacity is varied by altering the distance between the plates of the condenser even by a very minute amount there is a change of beat frequency which can be counted and by which the change in the interdistance can be measured.

Professor Whiddington found that it was quite possible to detect a change in distance between the plates of two to four thousandths of a millionth of an inch in the interdistance of the flat condenser plates. The plates were normally about one thousandth of an inch apart.

This apparatus is therefore capable of detecting a movement of the condenser plates to or fro of about 1,200 of a millionth of an inch, which is far less than that of a Whitworth screw micrometer. It could also be used to detect exceedingly small changes in dielectric constant of certain highly insulating liquids.

This invention can be applied in the design of many different instruments, as for instance in the construction of a microbalance where the tilt of the balance beam due to a weight is made to alter the distance between two condenser plates.

Other interesting applications of the thermionic valve in research are in the construction of instruments for measuring small high frequency voltages, currents and powers. The defect of all alternating current instruments depending on the heating power of the current is that as this heating varies as the square of the current the scale readings decrease more rapidly than the current.

Amongst such thermionic valve instruments may be mentioned the Moulin voltmeter, which enables the peak voltage and mean value of an alternating current of any wave form to be measured by the same instrument. F. B. Moulin described this instrument in August, 1928, in the *Journal of the Institution of Electrical Engineers* (Vol. 66, p. 886, 1928). It consists of a thermionic valve with filament heated by a 4-volt storage battery and the terminals to which the tested alternating voltage is applied connected to the grid and filament respectively of the valve, one through a high resistance shunted by a condenser for grid connection and a direct microammeter for the filament connection. This instrument has the great virtue that it absorbs little or no power. It is made in various forms by the Cambridge Instrument Company of England.

A very ingenious application of the three or two electrode valve has been made by Dr. H. E. M. Barlow in the construction of a valve ammeter for the measurement of small alternating currents of radio frequency. (See *Journal of the Institution of Electrical Engineers of London* for March, 1925. Paper first received in February, 1924.)

He constructs a Wheatstone's bridge circuit, two arms of which are formed of the interspace filament-to grid or filament to plate of two thermionic valves. The other two arms are suitable resistances, and a suitable microammeter is put in the bridge circuit and a high tension battery supplies current as usual to the circuits. A balance can then be obtained. The filaments of the valves are rendered incandescent by a suitable E.M.F. with a highly inductive coil in series. If, then, a small alternating current is superimposed on the direct filament heating current of one valve it upsets the bridge balance and causes a deflection of the microammeter.

It is then possible to calibrate the instrument so that

the readings of the bridge ammeter give the strength of the alternating current added to the direct heating current of one valve, and such calibration is valid for all frequencies.

It is made to give full scale deflections for A.C. currents of 5, 10, 20 or 30 milliamperes. Dr. Barlow has also made a useful arrangement of two electrode valves for measuring very small condenser capacities.

A thermionic wattmeter has also been devised by Dr. E. Mallett, in which two thermionic valves and a differential galvanometer are employed. But instruments of this type in which two valves of quite identical characteristics and a differential galvanometer are requisite are not very likely to come into any general use for commercial purposes.

The application shows, however, the extensive possibilities of the thermionic valve as an instrument for scientific research outside of and beyond its technical applications and general employment as an amplifier of voltage.

THE ELECTRONIC THEORIES OF LEWIS AND KOSSEL[1]

By Professor WILLIAM A. NOYES
UNIVERSITY OF ILLINOIS

In March and April of 1916 Kossel in Germany and Lewis in America proposed, quite independently, theories of the function of electrons in chemical combination, which have many ideas in common. Beginners in science and some older persons fail to understand the very complex nature of such theories at the outset and that as the years pass the theory is amplified and changed, slowly approaching, as we believe, the fundamental realities in the material universe. They always remain an imperfect expression for these realities, but those who have watched their development—how the changes are the result of the work of literally hundreds of different persons and how the important ideas of which the theories are made up are constantly checked by experiments of the most varied sorts find it difficult to believe that there is not a rather close correspondence between the ideas of the theory and actual facts.

The two theories had a common background, furnished, at basis, by the idea of Dufay, now two centuries old, that there are two kinds of electricity each having an attraction for its opposite and a repulsion for its own kind. The discovery of the electron, the atom of negative electricity, may be said to have begun with Faraday's experiments on the relation between electricity and chemical atoms a century ago, Helmholtz's interpretation of Faraday's experiments fifty years ago, Crookes's discovery of cathode rays in the late seventies and the determination of the mass of the electron by J. J. Thomson and by Kaufmann in 1897. Fourteen years later, Rutherford, by shooting positive alpha particles through a thin film of gold and noting their deflection, demonstrated that the positive portion of an atom is very small in comparison with the size of the atom. This, together with the known mass of the electron, one eighteen-hundredth of the mass of a hydrogen atom, showed that both the positive charge of an atom and nearly the whole of its mass are concentrated in the small nucleus at its center. Soon after, Moseley based the atomic numbers of the elements on the x-ray spectra from two electrons located close to the nucleus of each atom. The rotation of these electrons about the nucleus is more rapid as the electrons are drawn closer in when the positive charge is increased by one unit in passing from one atom to the next in the periodic system.

These ideas, which I have sketched very briefly and incompletely, gave the background on which Bohr and others based the theory of the structure of atoms as consisting of a central nucleus surrounded by successive groups of 2, 8, 18 and 32 electrons, but always with 8 electrons in the outer shell of a noble gas. These historical facts help us to understand how two men, 7,000 miles apart, should have proposed, independently, theories which have so many items in common.

The theories were proposed in 1916, during the great war, and soon after, Lewis and Kossel were on opposite sides in the world conflict. We may be sure that their theories will soon be fused together into a consistent, generally accepted whole. May we not take this as an omen that Hitler and Eden, who were in trenches just across the battle line, may help to piece the fragments together and build that permanent world peace which we so earnestly desire.

So far as I am aware, the first attempt to connect electrons with chemical phenomena was made by Lewis in March, 1902, when he was teaching elementary chemistry and drew in his notebook the crude figures which developed into his "cubical" atom. He considered the theory too speculative and waited fourteen years before he published it. J. J. Thomson, in 1904, proposed the hypothesis that an atom consists of a

[1] Presented before the Division of Physical Chemistry of the American Chemical Society, April 26, 1935. A comprehensive historical sketch of electronic theories will appear in *Chemical Reviews* for August.

uniform sphere of positive electrification within which electrons move about. He worked it out with elaborate mathematical detail. This will always remain a good illustration of the futility of mathematics when it is based on a false hypothesis. He contributed, however, the very important idea that atoms may be held together by static attraction due to the transfer of an electron from one atom to another. This is still a part of every electronic theory.

Abegg, in 1904, proposed a more qualitative theory in connection with his ideas of "principal" and "contra" valences. Abegg's ideas influenced both Kossel and Lewis.

The most important common idea contributed by both Lewis and Kossel was that every atom has a strong tendency to assume the stable form of a noble gas near it in the periodic system, by the gain or loss of one or more electrons. This led Kossel to a formula for the perchlorate ion in which the chlorine atom had assumed the structure of neon by the loss of seven electrons, and each oxygen atom had also assumed the structure of neon by the gain of two electrons.

While Lewis assumed that atomic ions may be formed in the same manner that was assumed by Kossel he added the thought that the noble gas structure may be formed in compounds by sharing pairs of electrons which belong in common to the atoms held together. Later, Langmuir used the term "covalence" to designate the pair of electrons. According to Lewis, the chlorine of the perchlorate ion has the structure of argon and has four covalences, while each oxygen atom has the structure of neon and has one covalence. Lewis called the portion of the atom within the group of valence electrons the "kernel." The kernel of chlorine has a positive charge of seven units and that of oxygen a positive charge of six units.

The electrons of a covalence are not equally shared by the two atoms, when these are different, but Lewis did not point out clearly that, so far as atoms at a distance are concerned, a covalence balances one positive unit charge in each atom. From this point of view, four of the seven positive charges of the chlorine kernel are balanced by the covalences and three are balanced by the negative electrons associated with the oxygen atoms. Since each oxygen atom with a single covalence has a residual negative charge of one unit the four oxygen atoms give a negative charge of one unit to the perchlorate ion. Reasoning of this sort enables us to select atoms in compounds, which have a residual positive or negative charge when we know their electronic structure. Kossel's theory does not have this advantage.

In 1901 Stieglitz, on the basis of the work of Jakowkin, recognized that the reaction between chlorine and water is ionic in character and assumed that the chlorine molecule separates into positive and negative ions. This is easily explained by assuming that when the atoms of a chlorine molecule separate the covalence electrons remain with one of the atoms. This prepares us to understand that two atoms held by a covalence may separate in three ways: (1) The electrons may go with the first atom, making that negative; (2) they may go with the second atom, leaving the first atom positive; (3) one electron may go with each, which will then be neutral.

Some interpretations of the wave quantum mechanics have replaced Lewis's cubical atoms by the tetrahedral arrangement which had been accepted by organic chemists sixty years ago on the basis of the work of Pasteur, Le Bel and van't Hoff. This has also given a picture of the relation of covalence electrons to the atoms held together which recalls the inclusive orbits suggested in a crude way by the author in 1917 and in a much better form by Campbell, Sidgwick and Knorr in 1923.

The facts that the carbon atoms of a doubled covalence are closer together than those of a single union and that the double bond increases the molecular volume of the compound indicate that the four electrons spread out on the two sides because of the tendency toward a tetrahedral structure. This recalls the old explanation for the cis-trans structure, and Baeyer's treatment of the double union as the limiting case for rings.

It will be seen from the above that Lewis's theory furnishes a simple explanation for many facts which are not so easily reconciled with the theory of Kossel.

OBITUARY

LUCIAN W. CHANEY

LUCIAN W. CHANEY was graduated at Carleton College in the class of 1878. He continued his studies for three years and then joined the faculty of his alma mater in 1882. In the following year he was made professor of biology and geology.

These were years of beginnings for Carleton, and the department to which Professor Chaney was appointed needed to be created by him. He was one of a group of Carleton's earliest faculty members who are known as the "Old Guard," who laid the foundation for high scholarship and character in the young college.

Professor Chaney's task in those early years was a heroic one. There were no microscopes or other equipment for laboratory work in biology, but he organized his courses with thorough laboratory instruction. He himself sought gifts and he and his family denied themselves necessities in order that he might save from a meager salary to buy precious instruments which he needed for his students. Those of us who had our work with him in the nineties look back to our courses with Professor Chaney with thorough satisfaction and the conviction that the courses in botany which we had with him in his little basement laboratory compare very favorably with modern courses with all their elaborate equipment.

Professor Chaney was both an able teacher and a good friend of every student in his courses. He gave free scope to the student's initiative to do things for himself. But he was always ready with sound advice and help when it was needed, and it was given in a spirit of friendly cooperation.

Professor Chaney also was interested in the students' social life. He may be justly considered the father of Carleton's athletics. This was also accomplished by letting the students do for themselves, while he was always behind the scenes ready with friendly advice and counsel. When Carleton had no athletic budget, Professor Chaney canvassed alumni friends with personal letters every year to raise a modest sum to help the boys.

Professor Chaney's work in geology was also of high character. The museum of geology and mineralogy which he organized was an excellent piece of work and was one of the show places on the Carleton campus. His explorations with Dr. Lyman B. Sperry in the Montana Rockies and their discovery of the glaciers in what was made later Glacier National Park were achievements of high merit.

Professor Chaney retired from the Carleton faculty in 1908, after twenty-five years of service, upon a pension from the Carnegie Foundation. But his great qualities as finder of facts, his clear scientific analysis, his deep interest in human welfare, his complete unselfishness and devotion to truth were still to find a new field of service of equal importance and wider scope. For almost another quarter century he labored in the Federal Bureau of Labor Statistics as a pioneer in the realm of fact finding and analysis to reduce industrial accidents. Dr. Chaney's achievements as a pioneer in two widely different fields speak eloquently concerning his clear-sighted intellectual qualities, his rectitude and his human sympathy and appreciation. He was a fine product of pioneer life of the West. His achievements are his monument.

FRANZ F. EXNER

CARLETON COLLEGE

SAMUEL HENRY ESSARY

PROFESSOR SAMUEL HENRY ESSARY, botanist of the Tennessee State Experiment Station at Knoxville, died suddenly of a heart attack on April 28.

Professor Essary was a descendant of pioneer stock in the western part of Tennessee. He was born at Chesterfield in 1870, the eldest of five children. He never married. After graduating from Union University, Jackson, Tennessee, he entered the University of Tennessee, taking the degree of master of science in 1907. Subsequently he studied for some time at the University of Wisconsin. His teaching experience in his earlier years included instructorships at La Grange College, Missouri, and Brenau College, Georgia. He then became associated with Professor S. M. Bain at the University of Tennessee, as instructor in botany, following him to the newly established State Experiment Station. After Professor Bain's death in 1918, Professor Essary became station botanist and head of the department.

Continuing the work begun by Professor Bain in the development of anthracnose resistant red clover, Professor Essary developed what is looked upon as the best red clover south of the Ohio River. His careful selection has given to the South "Tennessee 76" lespedeza, most valuable as a hay and pasture crop. His "Tennessee Red" and "Tennessee Pink" tomatoes, selected for wilt-resistance, have proved a boon to the truck farmers of the state. Forage and legume crops also held his close attention, and the work he did in selection for regional adaptation and economic usefulness along these lines is of undoubted value.

For several years past he had been devoting considerable time to the selection and breeding of cotton. "Trice," one of the best varieties grown along the northern cotton belt, is one of his improvements.

As a scientist his position is well established. But he was also a true naturalist, gifted with keen insight and unusual powers of observation. He knew thoroughly the Great Smoky Mountains and was a pioneer in blazing several of the trails included in the National Park. He was an excellent photographer, and many of his mountain pictures have appeared in newspapers and magazines all over the country. His botanical knowledge of the mountain flora made these of superlative worth. He left a botanical collection extending over forty years.

He was a most lovable man and his friends were deeply attached to him. Unobtrusive and unselfish, he never tried to advance himself, but was always extending a helping hand to others, especially younger men, about him. In his daily association with Professor Essary over a period of thirteen years the present writer grew to regard him as an elder brother in affection and a wise counselor in mutual undertakings.

LUDWIG STOLZ MAYER

RECENT DEATHS

DR. CHARLES RUSSELL BARDEEN, since 1904 professor of anatomy and since 1907 for twenty eight years dean of the University of Wisconsin Medical School, died on June 12 at the age of sixty four years

DR. WILLIAM THOMAS MAGRUDER professor of mechanical engineering emeritus at the Ohio State University, died on June 21 He was seventy four years old

DR ROBERT H HUTCHINSON, JR associate professor of the Department of Otolaryngology in the New York Post Graduate Hospital Medical School died on June 21 at the age of fifty six years

DR J G ESTES, professor of mathematics at North Carolina State College, was killed on June 1 when his plane crashed at the Raleigh airport

A CORRESPONDENT writes 'B F Loomis, of Anderson, Calif, died on June 11 at the age of seventy-eight years He was known principally for his photographic recording of the eruptions of Lassen Peak from 1914–17 His own version of the eruptions was published in a well illustrated volume under the title 'Pictorial History of Lassen Volcano' Mr and Mrs Loomis donated the equipped buildings and the grounds for the museum in Lassen National Park"

DR JULIUS BEREND COHEN professor of organic chemistry at the University of Leeds from 1904 until 1924, died on June 10 at the age of seventy six years

SCIENTIFIC EVENTS

OXFORD UNIVERSITY OBSERVATORY

A CEREMONY of inauguration of the new solar telescope took place on June 11 at the University Observatory, Oxford, in which Sir Arthur Eddington delivered an address on "The Physics of the Sun" This instrument, according to the London *Times* has been provided by the university in order that the observatory may have equipment adequate for the study of some phase of modern astronomy which is to be taken to mean the study of the physical nature and constitution of the stars as distinct from their positions, distance, brightness and distribution which had been the work of the previous directors, Professor Pritchard and Professor Turner The present occupant of the Savilian chair of astronomy and director of the observatory Professor H H Plaskett interprets this as calling for the study of the sun, the nearest of the stars, as a beginning, and has designed this solar equipment for investigation of the problems of the sunspots low temperature areas and the magnetic fields surrounding them, and the rotation of different surface zones of the sun

The instrument, made by the firm of Sir Howard Grubb Parsons Company, of Newcastle, with optical parts by Adam Hilger, of London, is essentially a small tower stationary telescope with five silver on quartz mirrors, the first of them which receives the light being a plane coelostat mirror 16 inches in diameter, while the effective concave mirror is 12 inches The result of the total combination is a stationary image of the sun about 8 inches in diameter that will be studied by means of a prism spectroscope, specially chosen in preference to a grating, that will give a high resolving power Advantages claimed for the instrument are first its compactness, secondly the fact that the mirrors are of quartz which has a coefficient of expansion one twentieth that of ordinary glass and would therefore give a small deformation of the image compared with other mirrors, and thirdly the large size of the prisms of the spectroscope The astrographic catalogue work that has been in hand for many years at the University Observatory is proceeding under Mr Bellamy and, though there has been no addition to the permanent staff, graduate members of the university and others have been engaged in research work in astrophysics at the observatory during the past year

THE DAVID DUNLAP OBSERVATORY

THE David Dunlap Observatory, which was officially opened on May 31 in the presence of a group of world famous astronomers is the gift of Mrs Jessie Donalda Dunlap to the University of Toronto in memory of her husband, David Alexander Dunlap The observatory is under the directorship of Professor C A Chant, head of the department of astronomy at the university, who, during the past thirty years has trained the majority of Canadian astronomers and to whom is largely due the present interest in astronomy throughout Canada

The Dunlap Observatory is situated on a slight rise fifteen miles north of Toronto at an altitude of 800 feet above sea level The grounds of the observatory consist of 179 acres which will later be developed into a park The observatory buildings include the administration building of white stone surmounted by three copper covered domes and, 50 yards to the north, the large 61 foot dome The latter houses the chief instrument of the institution, a 74-inch reflector by the Sir Howard Grubb Parsons Company This telescope is at present second only to the Mt Wilson 100 inch. The main mirror is a disk of Pyrex, 76 inches in diameter and just over a foot thick, cast by the Corning

Glass Company of Corning, N. Y. The telescope is equipped with a single prism stellar spectrograph by Hilger. Regular observation with this instrument was commenced early in June.

The administration building contains offices, library, machine shop, laboratories and lecture room. In the south dome is mounted a 19-inch reflector constructed by Professor R. K. Young, assistant to Professor Chant. The remaining two domes are at present empty, but it is hoped eventually to have a 12-inch refractor in one and a battery of short-focus photographic telescopes in the other.

The program of the observatory will be largely spectrographic in nature and will include studies of the radial velocities and physical constitution of stars fainter than sixth magnitude. Some direct photography at the Newtonian focus is planned, however, as the 74-inch telescope can conveniently be used with either the Newtonian or Cassegrainian arrangements. It is planned to reserve Saturday evenings for the public when those interested will have a chance to look through the telescope. In addition to this the observatory buildings will probably be open for inspection on certain afternoons during the week.

Mrs. Dunlap has, through her generous gift, provided the University of Toronto with an institution eminently suited for astronomical research of the highest importance.

THE HARVARD MINERALOGICAL MUSEUM

THE Harvard Mineralogical Museum has recently acquired the major part of the collection of Dr. Hans von Karabacek, of Vienna. Much of the new material has not been represented in the Harvard collection, and it is said that the acquisition is the most notable the museum has received since the bequest under the will of Albert F. Holden, '88, who died in 1913.

The new collection includes a large suite of the finest crystallized minerals from the copper mines of Tsumeb in German Southwest Africa. That locality is noteworthy for the variety and beauty of the compounds of lead, copper and zinc and the minerals secured are probably the finest specimens saved during the mining operations which have now ceased.

Professor Charles Palache, curator of the Mineralogical Museum, says of the new collection:

Of the nine cuprites (oxide of copper), one is probably the finest specimen of this mineral ever found anywhere. There are some fifty specimens of azurite and malachite, the carbonates of copper. The more than fifty specimens of the carbonate of lead, cerussite, and the twelve specimens of the sulphate of lead, anglesite, are not only the finest of their kind, but no two are identical. Twelve specimens of wonderfully colored carbonate of zinc, smithsonite, are also unusual.

Next in importance to these in the collection is a magnificent suite of fluorites from the long extinct mines of Cornwall in England, which are of extraordinary beauty, form and coloring.

Other suites worthy of mention are nearly thirty crystallized hematites from European localities; twenty specimens of epidote from the most famous Alpine locality for this mineral; five emeralds, each better than any hitherto in the collection, and a beautiful suite of titanite from the Alps.

Most of the specimens were selected because of their unusual quality. There were, however, a number of minerals not uncommon and not of particularly fine quality, but representing localities, mostly European, unrepresented in our collection.

THE CORNELL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE summer convention of the American Institute of Electrical Engineers, which was held at Cornell University from June 24 to 28, brought together more than 1,500 electrical engineers from all parts of the United States and foreign countries. This is the first time that the institute has held its convention at a university. Professor Robert Franklin Chamberlain was chairman of the convention committee.

The American Institute of Electrical Engineers has a membership of over 15,400 engineers in the United States and throughout the world. Its object is the advancement of the theory and practice of electrical engineering and of the allied arts and sciences and the maintenance of a high professional standing among its members.

Among the events were an address of welcome by Dr. A. R. Mann, provost of the university; the award of several prizes for papers; reports of progress in electrical devices which protect homes against burglars and kidnapers; an inspection of the Cornell campus, and of the largest telescope mirror in the world at the Corning Glass Works.

There was also a discussion of the rôle of the electrical engineer in a changing world, and of how he can apply his scientific knowledge to solve social and economic problems. A round table discussion was arranged on the problems of student and cadet engineers.

Professor Takai, of the University of Tokyo, gave an address on the electrochemical and electrometallurgical industries of Japan and several papers were presented discussing the Boulder Dam hydro-electric project. A brief outline of the program follows:

TECHNICAL CONFERENCES

Subject	*Chairman*
Problems of the Student and Cadet Engineer	M. G. Malti
D. C. Test Code	R. W. Owens
Transformers	J. E. Clem
Research on Insulating Oils	K. S. Wyatt
Noise	P. L. Alger
Mercury Arc Rectifiers	O. K. Marti
Dielectric Theories	H. H. Race
Circuit Breaker Standards	R. T. Henry
Reactance of Synchronous Machines	C. M. Laffoon
Electrical Engineering Curricula and Educational Methods	V Karapetoff
Distribution Transformer Protection	K. B. McEachron
Tensor Analysis	E. E. Dreese
Conductor Vibration	D. M. Simmons

TECHNICAL SESSIONS

Instruments in Measurements	W. B Konwenhaven
Power Generation	H. W Leitch
Electrical Machinery	V. M Montsinger
Protective Devices	H. P. Sleeper
Education	L. A. Doggett
Application of Electricity to Iron and Steel Production	R. W. Graham
Electrochemistry and Electrometallurgy	N. R. Stansel
Power Transmission	D. M. Simmons

HONORARY DEGREES CONFERRED BY HARVARD UNIVERSITY

TWELVE honorary degrees were conferred by Harvard University at its commencement on June 20 These included the doctorate of laws on Henry Agard Wallace, Secretary of Agriculture, on Dr. John Campbell Merriam, president of the Carnegie Institution of Washington, and on Dr. George Sarton, lecturer on the history of science at Harvard University. The doctorate of science was conferred on Dr. Albert Sauveur, McKay professor of metallurgy; on Dr. Waldemar Lindgren, emeritus professor of economic geology at the Massachusetts Institute of Technology; on Dr. Charles Schuchert, emeritus professor of history and geology, Sheffield Scientific School, and curator of geological collections, Peabody Museum, Yale University, and on Dr. Albert Einstein, of the Institute for Advanced Study at Princeton, N J. The degree of master of arts was conferred on Dr. Walter Prentice Bowers, physician.

The citations made by President Conant in conferring the degrees are as follows:

DOCTOR OF LAWS

HENRY AGARD WALLACE, doctor of laws—A public servant of deep faith and high integrity, who finds courage to attempt an uncharted journey in our modern wilderness

JOHN CAMPBELL MERRIAM, doctor of laws—A distinguished scientist whose wise administration of the Carnegie Institution has advanced knowledge on many fronts.

GEORGE SARTON, doctor of laws—Historian of science and of learning, a scholar whose relentless toil and inspired vision are creating a new academic discipline.

DOCTOR OF SCIENCE

ALBERT SAUVEUR, doctor of science—Long famous as a founder of the science of metallography, a Harvard professor of whose achievements we shall be forever proud.

WALDEMAR LINDGREN, doctor of science—A geologist to whom all men turn for knowledge of the metallic secrets hidden in the rock.

CHARLES SCHUCHERT, doctor of science—Eminent paleontologist of Yale, who has mapped the ancient seas and fathomed the geologic past

ALBERT EINSTEIN, doctor of science—Acclaimed by the world as a great revolutionist of theoretical physics, his bold speculations, now become basic doctrine, will be remembered when mankind's present troubles are long forgotten.

MASTER OF ARTS

WALTER PRENTICE BOWERS, master of arts—A physician devoted to his calling, for more than forty years a general practitioner in Worcester County, he has brought skill and wisdom to countless homes.

SCIENTIFIC NOTES AND NEWS

THE American Association for the Advancement of Science and the associated scientific societies are meeting this week in Minneapolis. A full report of the meeting together with some of the more important addresses and papers will be printed in early issues of SCIENCE.

DR. IRVING LANGMUIR, associate director of the Research Laboratory of the General Electric Company, Schenectady, N. Y., has been elected a foreign member of the Royal Society, London.

DR. THOMAS HUNT MORGAN, director of the Wm. G. Kerckhoff Laboratories of the California Institute of Technology at Pasadena, has been elected a corresponding member of the Prussian Academy of Sciences.

DR. E. D. MERRILL, for the past six years director of the New York Botanical Garden, has accepted appointment as professor of botany and administrator of botanical collections at Harvard University. His work will involve the administration of the several independent botanical units of the university, including the Arnold Arboretum, the Gray Herbarium, the Farlow Herbarium and Library, the Botanical Museum, the Botanic Garden, the Bussey Institution and the Harvard Forest.

DR WILLIAM OTIS HOTCHKISS, since 1925 president of the Michigan College of Mining and Technology, previously for six years state geologist of Michigan, has been elected president of Rensselaer Polytechnic Institute He succeeds the late Palmer C Ricketts, who had been president since 1901

DR HENRY NORRIS RUSSELL, professor of astronomy and director of the observatory of Princeton University, delivered the George Darwin Lecture at a meeting of the Royal Astronomical Society on June 14, taking as his subject The Analysis of Spectra and its Applications"

DR RALPH HOWARD FOWLER, Plummer professor of mathematical physics at Trinity College, Cambridge, England, has been appointed visiting lecturer in mathematics at Princeton University for the second term of next year

THE Susan Colver Rosenberger Medal, given each year to an alumnus of Brown University for distinguished service to humanity, has been awarded to Dr Charles V Chapin, for forty two years superintendent of the department of health of Providence, R I

THE Leeuwenhoeck Gold Medal of the Royal Academy of Sciences, Amsterdam, has been awarded to Professor S N Winogradsky, director of the Division of Agricultural Microbiology of the Institut Pasteur, Brie Comte Robert, France, for his contributions to the development of soil microbiology The medal is awarded every ten years in commemoration of the discovery of microorganisms by Anton van Leeuwenhoeck.

AT the University of Wisconsin the degree of doctor of laws was conferred at commencement on Dr James Bryant Conant, president of Harvard University, and the degree of doctor of science on Professor Gilbert Ames Bliss, head of the department of mathematics of the University of Chicago

DR. ISAIAH BOWMAN, president-elect of the Johns Hopkins University, received the degree of doctor of laws at the commencement of Dartmouth College

THE honorary degree of doctor of science was conferred on James T Jardine, chief of the Office of Experiment Stations, U S Department of Agriculture, by the Kansas State College of Agriculture and Applied Science, at its commencement exercises on May 27

THE University of Colorado at commencement conferred the degree of doctor of science on Dr Florence Rena Sabin, member of the Rockefeller Institute for Medical Research, the degree of master of science was conferred on Darwin Andrews, horticulturist and botanist of Boulder

DR. HAROLD CLAYTON UREY, professor of chemistry at Columbia University, received the degree of doctor of science at the commencement exercises of Princeton University In presenting the degree, Professor L. P Eisenhart, dean of the graduate school, spoke as follows "Harold Clayton Urey, professor of chemistry in Columbia University, awarded the Nobel Prize in chemistry for his discovery that ordinary hydrogen gas is not simple, but contains a second isotope of mass two, subsequently, in collaboration with the late Dr Edward Washburn, he located abundant sources of the new hydrogen in electrolytic cells and devised a method to produce pure heavy water in quantity, a bold investigator with a mastery of advanced experimental technique and the theoretical aspects of the new chemistry Happily timed from the standpoint of science, his discoveries have enriched chemistry and physics, and revealed a rich and inexhaustible domain which others are developing in Princeton and elsewhere"

THE doctorate of science was conferred at the commencement of Yale University on Dr Carl Emil Seashore, for thirty years head of the department of psychology at the State University of Iowa In conferring the degree President Angell said "Eminent scientist, teacher, administrator Your long and successful career is a monument to the power of tireless industry when wedded to high intelligence, shrewd ingenuity and sound judgment From small and feeble beginnings, you have built steadily and without interruption a great scientific edifice which has served humanity well and brought you just renown Your Alma Mater, in recognition of your signal achievement, confers upon you the degree of doctor of science, admitting you to all its rights and privileges"

DR A E MURNEEK, of the University of Missouri, has been elected *president*, Dr D R Hoagland, University of California, *vice president*, and Dr W F Loehwing, University of Iowa, *secretary-treasurer*, of the American Society of Plant Physiologists for the year 1935–36

DR GEORGE W GRIER, of Pittsburgh, was elected president of the American Radium Society on June 11 at the Atlantic City meeting

THE Victorian Branch of the council of the British Medical Association at its meeting on June 5 appointed Lieutenant-Colonel Sir James W Barrett president elect for the year 1935–36, to take the place of Sir Richard Stawell, who died on April 18 and who was to have presided over the annual meeting in Melbourne next September Sir James Barrett is vice chancellor of Melbourne University and consulting surgeon to the Victoria Eye and Ear Hospital.

DR. OTIS W CALDWELL, since 1917 professor of education at Teachers College, Columbia University, having reached the age for retirement, has been made professor emeritus Dr Caldwell, before going to New York, was professor of botany at the University of Chicago He was director of Lincoln School, Teachers College, for ten years and later director of the Institute of School Experimentation His work as general secretary of the American Association for the Advancement of Science and other scientific work will be done from an office in the Boyce Thompson Institute for Plant Research, at Yonkers, N Y

DR. JOHN LEIGHTON BRAY, professor of metallurgy at Purdue University, has been appointed head of the School of Chemical Engineering to succeed Professor H C Peffer, who died last summer

NEIL P BAILEY, professor of mechanical engineering at the Iowa State College, has been appointed head of the department of mechanical engineering at Rutgers University He succeeds Dr Robert C H Heck, who becomes research professor of mechanical engineering

DR. HUGH J MORGAN, professor of clinical medicine, has been elected professor of medicine in the Vanderbilt University School of Medicine, to succeed Dr C Sidney Burwell, who was recently elected dean and professor of research medicine at the Harvard University Medical School

AT Princeton University, Dr Henry DeWolf Smyth, associate professor, has been made chairman of the department of physics to succeed Professor Edwin P Adams, who has resigned Dr William Taylor Thom, Jr, has been promoted to a professorship of geology and Assistant Professor Marcus S Farr has become associate professor

PROFESSOR I M HEILBRON has been appointed Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories of the University of Manchester in succession to Professor Arthur Lapworth, who has retired Dr Colin Campbell, senior lecturer in chemistry, will be assistant director of the laboratories

DR. ARTHUR J BALLANTYNE has been appointed to the new chair of ophthalmology, established under the terms of the will of Dr Gavin Tennant, at the University of Glasgow

DR. ANDREW TOPPING, of the Public Health Department of the London County Council, has been appointed lecturer in hygiene and public health at Charing Cross Hospital Medical School in succession to the late Dr C W Hutt

DR. GEORGE FREDERICK HERBERT SMITH, since 1921 secretary of the British Museum (Natural History), has been appointed keeper of mineralogy, to succeed Dr L J Spencer, who will retire on July 7

DR. HOWARD IRVING COLE, formerly chief chemist of the Philippine Health Service, has been appointed by the League of Nations to conduct research work at the International Leprosy Center recently established at Rio de Janeiro The new center was founded by the Brazilian Government under the auspices of the League of Nations with the aid of grants from the league, the Brazilian Government and M Guilherme Guinle, a philanthropist of Rio de Janeiro The objects of the center are research, instruction and the development of a world wide cooperation in the campaign against leprosy

DR. R RUGGLES GATES professor of botany at King's College, University of London, plans to spend August and September in Canada and the United States

DR CHARLES N FREY, director of the Fleischmann laboratories, addressed the American Association of Cereal Chemists at Denver on June 7 on "Yeast" The lecture was followed by a moving picture illustrating the manufacture and some of the uses of yeast

A NEW library and a new chemistry building were dedicated at the University of Arkansas on June 10 The speakers at the library dedication were Senator Joe T Robinson, Charles T Coleman, of Little Rock, and Edward J White, of St Louis Dr Edward Bartow, president elect of the American Chemical Society, made the chief address, entitled "The House of Chemistry," at the dedication of the chemistry building Brief addresses were made by alumni and by H E Wiedemann, grand master alchemist of Alpha Chi Sigma, chemical fraternity

APPLICATIONS must be on file not later than July 15 with the U S Civil Service Commission at Washington, D C, for the positions in the Forest Service, Department of Agriculture, of senior technical editor, $4,600 a year, technical editor, $3 800 a year, and associate technical editor, $3,200 a year

MISS HELEN GREENWOOD, of Worcester, Mass, has presented to the department of botany of Wellesley College her collection of mosses and hepatics numbering one thousand specimens The collection includes Miss Greenwood's personal collections in Massachusetts, Maine, Nova Scotia, the Canadian Rockies, the Western Coast, and England, and gift and exchange specimens from England, Scotland, France, Sweden and Canada.

THE Belgian Scientific Research Fund presented

on June 12 to the Science Museum, South Kensington, the nacelle of the balloon used by Professors Piccard and Max Cosyns in their second ascent into the stratosphere. Professors Piccard and Cosyns were present and M. Jean Wilhelms, the director of the fund, made the presentation.

TUFTS COLLEGE has completed the construction of a new biological wing of the Barnum Museum. The wing will contain laboratories for histology, embryology, physiology, bacteriology and general biology, as well as offices for the staff. In the entrance hallway has been placed a tablet in memory of Professor Fred Dayton Lambert, who for more than a generation taught biology at Tufts College. The funds for the new wing were left by Phineas T. Barnum.

THE *Philadelphia Inquirer* states that the American Philosophical Society may not accept the bequest of the late William Wood. The residuary estate which the society was to receive was estimated at $2,000,000 and was to have been used for the erection of a new building. A number of rulings which will affect the amount the society would receive are now under consideration by Judge Charles Klein, of Orphans' Court. Mr. Wood, who was eighty-four and a bachelor, left an estate originally estimated at $5,000,000. The present accounting shows a balance of $1,270,571, not including real estate.

A PROGRAM for the expenditure of $156,298,000 of work-relief funds for forestation in the semi-arid areas of the tree shelter belt zone of the Midwest, as well as in existing foreign preserves, has been advanced by the Forest Service. On May 31 request for the money was made to the Division of Applications in the works program. The forestation program, which would give work in forty-seven states as well as in Alaska, Puerto Rico and the District of Columbia, would be expected to give impetus to the shelter belt project of Dr. Rexford G. Tugwell, Under Secretary of Agriculture. The fund is contemplated for use in a variety of forestry projects. These include such work as the construction and maintenance of fire-breaks, forest fire lookout houses, towers and observatories, landing fields, telephone lines, forest roads and trails; housing for forest officers, miscellaneous buildings and structures and shelter belt planting.

IT is planned to establish, according to the *Journal* of the American Medical Association, in the Rudolf Virchow-Krankenhaus in Berlin a central cancer institute that is to serve all northern Germany. It will be both a therapeutic and a research center. As the first step, a large committee has been appointed, on which, among others, the whole Berlin faculty of medicine will serve, Professor Sauerbruch being the chairman. For this institute, which is to be directed by Professors Cramer and Hintze, a suite of rooms with 300 beds has been selected.

Nature, in reporting the renaming of the Physical Institute of the University of Heidelberg, writes: "The Physical Institute of the University of Heidelberg has recently, in honor of Professor Lenard, been renamed the 'Philipp Lenard-Institut.' A correspondent has sent us a cutting from the students' magazine of that university, giving Professor Lenard's reply to the congratulations of the Heidelberg students on this occasion. The following is a translation of Professor Lenard's reply, and we prefer to make no comment upon it: 'I am very grateful to the students of the University of Heidelberg for their congratulations on the renaming, by the Ministry, of the institute which was built some years ago under my direction. I hope that the institute may stand as a battle flag against the Asiatic Spirit in Science. Our Leader has eliminated this same spirit in politics and national economy—where it is known as Marxism. In natural science, however, with the over-emphasis of Einstein, it still holds sway. We must recognize that it is unworthy of a German—and indeed only harmful to him—to be the intellectual follower of a Jew. Natural science properly so-called is of completely Aryan origin and Germans must to-day also find their own way out into the unknown. Heil, Hitler!'"

DISCUSSION

THE NEW ACTIVE PRINCIPLE OF ERGOT

THE isolation of a new highly important constituent of ergot has recently been announced by Dudley and Moir,[1] and Kharasch and Legault.[2] Since I[3] described the isolation of what is clearly the same substance almost a year before either of these groups of workers, it seems highly desirable that certain facts be presented in order to clarify the rapidly developing confusion and to prevent still more names from being assigned to the same substance.

During the decade preceding 1932, pharmacologists and clinicians accumulated a vast amount of evidence which resulted in what was tantamount to a unanimity

[1] Dudley and Moir, *Brit. Med. Jour.*, March 16, 1935.

[2] Kharasch and Legault, SCIENCE, 81: 388, 1935.

[3] Thompson: Doctorate dissertation, Johns Hopkins University, 1934; abstracts published in *Jour. Am. Pharm. Ass'n.*, 21: 853, 1932; 21: 1135, 1932; 22: 736, 1932; 24: 24, 1935; 24: 185, 1935.

of opinion to the effect that the specific alkaloids ergotoxine and ergotamine were the carriers of the full clinically valuable oxytocic activity of ergot Consequently, methods of manufacture of and standardization procedures for pharmacopoeial preparations were so selected as to insure the presence of standardized amounts of the specific alkaloidal activity in the finished product,[4] [5] etc In June, 1932, Moir[6] reported the experimental evidence which was responsible for a reopening of the entire ergot problem Briefly, he clearly demonstrated that the available alkaloids ergotoxine and ergotamine were greatly inferior to crude extracts in their oxytocic activity upon puerperal human patients Because he obtained prompt and intense activity from aqueous extracts (*poor in* alkaloids) as well as from hydro-alcoholic extracts (rich in *alkaloids*), he *concluded that the valuable* oxytocic activity of ergot resided, not in the specific alkaloids, but in a "new principle as yet unidentified"

Since the publication of a series of ten articles dealing with the pharmacology of ergot in 1929 and 1930, I continued to study the active principles and various extracts on pregnant animals, especially the cat In August, 1932, approximately two months after Moir's important report appeared, I reported[7] [8] similar observations upon the pregnant cat and confirmed his prediction of the existence of a highly important hitherto unidentified principle in ergot by the actual isolation of the substance responsible for the prompt and intense oxytocic activity The substance had not been obtained in crystalline condition but was highly active Contrary to Moir's and Dale's[9] belief (see also footnotes 10 and 11) this new substance was reported[12] *to possess* alkaloidal properties In May, 1934, I reported,[13] [14] the isolation of the new substance in crystalline form and described its properties, classifying it definitely as a new member of the total specific *alkaloids* of ergot I did not assign a name to the new alkaloid up to that time because of the almost simultaneous appearance of Kussner's[15] announcement of the new alkaloid "Ergoclavin" To avoid confusion, I called my principle "X alkaloid" until I was certain of its identity A comparative study of the properties of the two new alkaloids soon revealed highly significant differences which set them apart as separate entities Accordingly, also in May, 1934, I assigned the name "Ergostetrine" to my "X alkaloid"[16] Ergostetrine shows a number of properties which clearly differentiate it from any previously described alkaloid of ergot, but the one difference of greatest possible importance lies in the fact that its oxytocic activity develops much more promptly and much more intensely than even much larger doses of any one or all of the hitherto known alkaloids, including Sensibamine and Ergoclavin

In February, 1935, there appeared an article by Davis, Adair, Kharasch and Legault,[17] embracing a report presented at the meeting of the Central Association of Obstetricians and Gynecologists, November 1 to 3, 1934, New Orleans, announcing the isolation of the new powerfully and promptly acting principle In this report, their experimental evidence dealt with a purified amorphous concentrate which was not chemically identified, but which was stated to be ***non-alkaloidal*** (in agreement with Moir's and Dale's original belief, but in opposition to my identification of the substance) They called this amorphous impure substance 'Ergotocin," *although they stated in a footnote* that they had recently obtained the substance in crystalline form No evidence as to its identity was given, except that it was non alkaloidal because it was obtained from their impure non alkaloidal "Ergotocin"

On March 16, 1935, Dudley and Moir[18] announced that they had isolated the important oxytocic substance in crystalline form This constituted the first confirmation of my original identification of the new substance as an alkaloid and, it will be noted, it represents a change from the original view held by the British workers (see footnotes 6, 9, 10, 11) This left only the University of Chicago workers[19] opposed to my identification of the new substance as an alkaloid since Dudley and Moir clearly classified their principle as an alkaloid and named it "Ergometrine"

In February, 1935, Koff[20] also concluded that the new substance is alkaloidal in nature, although it should be pointed out that his conclusion was based upon the chemical and pharmacological evidence with which I supplied him, his own work consisting wholly

[4] Fluid Extract of Ergot, U S P, 10th revision

[5] Liquid Extract of Ergot, B P, 1932 edition.

[6] Moir, *Brit Med Jour*, 1119, June 18, 1932

[7] Thompson, *loc cit*

[8] Thompson, report presented at the Toronto meeting of the American Pharmaceutical Association, August 22, 1932

[9] Dale, Note appended to Moir's report, see footnote 6

[10] Lecture on ergot by Barger, with discussion, *Pharm Jour*, 597, November 18, 1933

[11] Thompson, *Jour Am. Pharm. Ass'n*, 24, footnote on page 189, 1935

[12] Thompson, *loc cit*, note 8

[13] Thompson, report presented at the Washington meeting of the American Pharmaceutical Association, May 10, 1934.

[14] Thompson, U S Patent Office· Application No 740,199, submitted May, 1934

[15] Küssner, E. *Merck's Jahresbericht*, 47 5, 1934

[16] See footnote 14

[17] Davis, Adair, Rogers, Kharasch and Legault, *Am. Jour Obstet and Gynecol*, 29 155, 1935

[18] *Loc cit*

[19] Davis, Adair, Rogers, Kharasch and Legault, *loc cit*

[20] Koff, *Surg, Gynecol. and Obstet*, 60 190, 1935

of the clinical experiments, which, incidentally, confirmed the validity of my pharmacological approach Due credit is accorded me in Dr Koff's report

In April, 1935, Kharasch and Legault[21] reported the isolation of their new principle in a crystalline condition, claiming to have obtained it in December, 1934, and naming it "Ergotocin" This is the name originally used for their impure concentrate It is of interest to note that my Ergostetrine was isolated and identified exclusively in the laboratory, by chemical and pharmacological methods, whereas Dudley's and Moir's Ergometrine and Kharasch's and Legault's Ergotocin were subsequently but independently obtained with the aid of numerous clinical observations upon puerperal humans The validity of the results obtained by my pharmacological methods was, of course confirmed by clinical experiments conducted by Dr Koff and others

While there is yet much to be done in studying the properties of the new principle, it is believed that the already existing evidence conclusively shows that my Ergostetrine, Dudley's and Moir's Ergometrine and Kharasch's and Legault's Ergotocin are one and the same substance, and that this substance is unquestionably an alkaloid It is unfortunate that delays in publication have resulted in the confusion already existing My Ergostetrine was identified as an alkaloid which melts and decomposes at 154 to 155 5 degrees Centigrade, and whose 0 1 per cent solution in chloroform is laevo rotatory to the extent of approximately 50 degrees[22, 23] Dudley and Moir[24] reported their Ergometrine to melt and decompose at 150–152 degrees Centigrade, and the optical activity of a 0 1 per cent solution in chloroform to be 45 degrees laevo rotatory Kharasch and Legault[25] state that their Ergotocin (non alkaloidal?) melts and decomposes at 155 degrees Centigrade, and although they fail to give specific rotation, they state that crystalline Ergotocin "as so far obtained, is dextro-rotatory" In support of my contention that Ergostetrine, Ergometrine and Ergotocin are one and the same substance, it will be noted that my decomposition point is in agreement with that of Kharasch and Legault, but that the optical activity of my Ergostetrine differs from the claim of the same workers On the other hand, it will be noted that the optical activity of my Ergostetrine is in reasonable agreement with that reported by Dudley and Moir for their Ergometrine, while their decomposition point is definitely lower than for my Ergostetrine In explanation of these differences, it should be noted that Dudley and Moir admit the possible slight impurity of their crystalline Ergometrine, thus accounting for the slight difference in our respective observations on optical activity and decomposition point The decomposition point of my crystalline Ergostetrine agrees excellently with that reported by Kharasch and Legault for their Ergotocin This leaves the only important point of difference among the three named substances to be that Kharasch and Legault report their substance dextro-rotatory, while Dudley and Moir and I agree that the substance is laevo rotatory In connection with the latter point which might indicate that the principle isolated by Kharasch and Legault differs from that isolated by myself and that of the British workers, I would point out that through the courtesy of Eli Lilly and Company, I have had the opportunity of examining crystalline Ergotocin Under identical conditions, crystalline Ergotocin and crystalline Ergostetrine were found to be identical as to decomposition point, optical activity and oxytocic activity on pregnant cats, all data being in agreement with that assigned by me for Ergostetrine[26, 27] I consider it a virtual certainty that, as increased amounts of the material become available, others will confirm my contention that the three names have been independently assigned to the same substance

In April, 1935, I read a paper[28] summarizing the pertinent literature and describing the chemical and pharmacologic properties of my alkaloid "Ergostetrine," emphasizing its laevo rotation (−45 to −50 degrees) in chloroform solution, its decomposition point (154 to 155 5 degrees Centigrade), the fact that it crystallizes readily from chloroform and benzol, less readily from ether, that it gives a strong Cockscomb reaction, and Smith Color reaction, and that it occurs in different lots of ergot to the extent of 0 05 to 0 2 mg per gm Clinical studies on over 350 puerperal human patients by Dr Vernon Tuck, of the Philadelphia General Hospital, have been completed and will be reported in due course, the Ergostetrine having been given orally, rectally and intramuscularly The human dosage is in agreement with that reported by Dudley and Moir and the University of Chicago workers

Just prior to sending this note to press, a discussion by the British workers in the June 7 issue of SCIENCE came to my attention With the information at their disposal, I am impressed with their accuracy and fairness, in the treatment of the controversial points They are laboring under a wrong impression, however,

21 *Loc cit*

22 See footnote 14

23 Thompson, report presented at the Detroit meeting of the American Society for Pharmacology and Experimental Therapeutics, April, 1935

24 *Loc cit*

25 *Loc cit*

26 See footnote 14.

27 See footnote 23

28 *Ibid*

regarding several phases. Referring to the footnote in my article which appeared in March, 1935, they state that "Thompson reports a later success in crystallizing what was very probably our Ergometrine" That the three independently obtained substances are identical is now established, but I would emphasize that my footnote did not refer to a 'later success This same footnote is contained in the bound copy of my doctorate dissertation, which was accepted by the Johns Hopkins University prior to May 1, 1934, and it constituted a part of my March, 1935, article at the time it was submitted for publication in the *Journal* of the American Pharmaceutical Association on May 10, 1934, more than nine months prior to the announcement of crystalline Ergometrine by Dudley and Moir or the subsequent announcement of crystalline Ergotocin by Kharasch and Legault

I would add my support to the suggestion by our British colleagues that a single scientific name be decided upon for this new important alkaloid, but unfortunately my name 'Ergostetrine' is not a mere matter of "note-book record" This name was both scientifically and legally assigned[29] by me in May, 1934 I would emphasize the importance of a universal agreement establishing a single place of registration for new names assigned to complex new plant or animal constituents, without the necessity of patent application to establish a point on a definite date

MARVIN R THOMPSON

SCHOOL OF PHARMACY
UNIVERSITY OF MARYLAND

THE CROSS-INOCULATION OF BACTERIAL-PLANT GROUP OF CICER

THE isolation of pure cultures of the root nodule bacteria, cross inoculation and strain efficiency studies on *Cicer arietinum* L and other species of Indian leguminous crops were conducted by the writer at the University of Wisconsin during 1931–33 It was found that the root nodule bacteria of *Cicer arietinum* L are specific for that host plant and may be considered a separate group not belonging to the pea group as stated by Simon[1] A preliminary mention of this finding appeared as a footnote in the monograph of Fred, *et al*,[2] and the detailed paper has recently been submitted to the *Indian Journal of Agricultural Science*

Rasumowskaja[3] has recently reported on the specificity of *Cicer arietinum* L for nodule production and states that it does not belong to the pea group This author does not appear to have noticed the previous mention of this by Fred, *et al*[2] His work was confined to inoculation of *Cicer arietinum* with the crushed nodules of *Vicia sativa*, *Vicia cracca* and *Pisum sativum* and pure cultures of nodule bacteria of pea and vetch only, whereas the present writer's conclusions have been based upon studies on cross inoculations with pure cultures of all the known bacterial plant groups

M S RAJU

AGRICULTURAL RESEARCH INSTITUTE
COIMBATORE S INDIA

[29] See footnote 14

[1] J Simon, *Centbl Bakt* (etc), 2 Abt 41 470–479, 1914

[2] E. B Fred *et al.*, University of Wisconsin Studies in Science, No 5, footnote on p 127, 1932

[3] S G Rasumowskaja, *Centbl Bakt* (etc), 2 Abt 90 330–335, 1934

VITAMINS?

IN the early days of vitamin research, classification by alphabetic order was accepted as a temporary convenience Indirectly this lettering of unknown, quasi mysterious substances did much to popularize them and to make the world vitamin-conscious

The crystallization the isolation and our more or less definite knowledge of the physiological properties of the so called vitamins show that there is no longer any scientific basis to maintain such widely different chemical substances as carotenes, ascorbic acid irradiated sterols, pyrimidine thiazole compounds sodium phosphate, manganese compounds, etc, under the same heading, except perhaps for historical purposes.

The academical disagreement between British and American biologists over mere initials to be given to otherwise well defined products adds to the confusion

Anti neuritic, anti scorbutic anti rachitic, anti anemic, anti goitric, etc, substances should be classified with the chemical family to which they belong or grouped with the natural or pharmaceutical substances which have closely related physiological properties

The vague expression "vitamin' will eventually join the musty company of phlogistic, humors animalcules and kindred antiquated terms

ANDREW MOLDAVAN

CYTOGENETIC NOTES ON SPHAERALCEA AND MALVASTRUM

No chromosome numbers in the genus *Sphaeralcea* have been recorded previously The only chromosome number reported for a closely related genus is that of 21 pairs in *Malvastrum capense* Gray and Harvey[1]

Recently the chromosome numbers of approximately 15 species, 20 subspecies and 2 botanical forms of the subgenus *Eusphaeralcea* from the southwestern United States have been determined The basal chromosome number for the subgenus is 5 The prevailing numbers are 5 and 10 pairs, but 15 pairs are of frequent occurrence Only one form with 25

[1] A. H S Stenar, *Akad Abhand Upsala*, 1–75, 1925

pairs has been encountered, and none, so far, with 20 pairs. Among approximately 275 plants examined, 12 were apparently natural hybrids. During meiosis these plants exhibited chromosome behavior typical of hybrids.

Of forms usually referred to *Sphaeralcea* but not belonging to the subgenus *Eusphaeralcea*, the writer finds that *S. rivularis* (Doug.) Torrey has 33 pairs of chromosomes and that *S. umbellata* (Cav.) Don and *S. abutiloides* (L.) Don, have 17 pairs. Six species and 2 subspecies of the related genus *Malvastrum* (subgenus *Malacothamnus*) were found to have 17 pairs of chromosomes.

The subgenus *Eusphaeralcea* is unique in that it presents the lowest basal chromosome number and the first highly polyploid group detected in the Malvaceae. In view of the occurrence of several 5-paired species, Davie's suggestion[2] that 7 is the ancestral basic number for this family can hardly be accepted.

The chromosome number of the California species of *Malvastrum* (the genus *Malacothamnus* of Greene) clearly separates this group from *Sphaeralcea*. The chromosome numbers, considered in relation to the morphological evidence,[3] indicate that Greene's genus *Iliamna*, represented by *S. rivularis*, Zuccarini's genus *Meliphlea*, represented by *S. umbellata*, and Desvaux's genus *Phymosia*, represented by *S. abutiloides*, may be well founded.

J. M. Webber

Bureau of Plant Industry
U. S. Department of Agriculture

SCIENTIFIC MEN AND THE NEWSPAPERS

I learn from a letter which my friend Howard W. Blakeslee, of the Associated Press, publishes in Science for June 14, 1935 (p. 591) that scientists should "speak the language of the newspapers" and that they should be more emotional. This implies that newspapers are thoroughly satisfactory in their methods of appeal.

A community gets exactly the kind of a newspaper that it can digest—no better, no worse. Editors are aware of this and present the news accordingly. If their readers all wore Phi Beta Kappa keys they would remold their policies.

I see no particular reason why the scientist should become emotional and talk in the vulgate because the newspapers will then give his utterances more space.

It is the business of the journalist and not of the scientist to present the discoveries of the laboratory so that the many will understand. But heaven forbid that the popularizer should rely too much on emotion. We have passed the stage when gasping wonder can pass for popularization. We need more journalists trained in science and not more scientists with a flair for popular writing.

Since newspapers are published to meet the needs of the people by men who know their business it follows that it is the school and the college that are at fault. If we had a public adequately educated in science it would not be necessary to explain the meaning of elementary technical terms and principles or to resort to the literary devices of the primary school reader to drive home the facts about a new discovery. The question that Mr. Blakeslee raises is one that must be solved not by laboratory workers or newspaper editors but by the faculties of our colleges and universities. To think that at this late day it is possible to print in only one American newspaper the simple equation that expresses the mass-energy relation of Einstein in a popular article on atomic physics with the realization that it will be understood by enough readers! If an educated Greek in the time of Pericles could discuss geometry at the dinner table it must have been because science was taught as a cultural subject. Give us high-school and college graduates with a broad knowledge of science and the newspapers will respond to their demands rapidly enough.

Waldemar Kaempffert,
Science Editor, The New York Times

SCIENTIFIC BOOKS

QUANTUM MECHANICS

Principles of Quantum Mechanics. By P. A. M. Dirac. Second Edition. Oxford, Clarendon Press. 1935. xi + 300 pp. $6.00.

The first edition of this book (1930) contained an absolutely reliable and authentic account of the foundations of quantum dynamics, its main methods and results. Naturally, it soon became an indispensable aid both to independent workers in this field and to advanced students preparing for independent work. The systematic use of the symbolic transformation theory, largely developed by Dirac himself, made the presentation in the larger part of the book concise, elegant and simple. It had, however, one serious drawback: the highly abstract character of the introductory chapters. In the first place, the notion of observables (see below) was introduced in a manner so detached from experiment that the reader may have remained unconvinced that their measurement is in all cases possible. In the second place, a rather

[2] J. H. Davie, *Jour. Genetics*, 28: 33–67, 1933.
[3] T. H. Kearney, *Univ. Calif. Publ. Bot.*, 19: No. 1, in press.

unusual meaning was assigned to the term "state" Having in mind the indeterminacies of atomic systems, the author aimed by this word at a characteristic which is at once but little affected by the uncertainties and is permanent in time (something like a generalization of the "stationary states") It must be admitted that such a concept is fundamental, and attractive as a basis of quantum mechanics But to use for it the word "state" is conducive to constant misunderstandings It was mainly due to these two features that the first part of the old edition made difficult reading, overtaxing the powers of abstraction of the less experienced student and making the book unsuitable as a classroom text

Both flaws are completely eliminated from the second edition The author does not forget for a moment to stress the experimental point of view and lives up in his exposition to the principle stated by him on page 5 "Only questions about the results of experiments have real significance and it is only such questions that theoretical physicists consider" The text is rewritten with a view of attributing to the word *"state"* its more common sense as the quantum analogue to the numerical values, at a given moment, of the coordinates and momenta of a classical dynamical system (While an *"observable'* is the analogue to the instantaneous numerical value of a classical variable or of a function of the coordinates and momenta) This meaning of the word "state" may be less fundamental for the quantum theory than that used in the first edition, but its didactic superiority is unquestionable It manifests itself in the fact that its use quite naturally divides the treatment into two parts—"part (I), dealing with relations and laws of nature governing the state of affairs in an atomic system at one instant of time, and part (II), dealing with the connexion between the state of affairs at one instant of time and at a slightly later instant" The content of the first part (Chapters II to V) is, from the mathematical point of view, the symbolic algebra of transformations and, from the physical, the statement of the limitations of our power of observation of small systems The second part (Chapters VI to XIII) is, in both respects, the analogue of the equations of motion of classical mechanics and contains all the special applications.

This change in the direction of making the exposition less abstract does not sacrifice, but rather enhances, its logical rigor and mathematical elegance It makes the book clear and simple in all its parts, and there is no longer any reason why it should not prove of excellent service as a text in advanced courses. In fact, the author's ability "to keep the physics to the forefront" is an important pedagogical advantage Paradoxically, it takes a great master of mathematics to give a truly physical presentation, and the formalism developed by Dirac is particularly adapted to keep the mathematical apparatus ancillary to the physical content

The subject matter is not materially changed in the new edition One of the most important events, since the appearance of the old one, was the discovery of the positron It was a triumph of Dirac's theory of the electron because it supplied a physical interpretation of the negative energy states Questions relating to the formation of electron positron pairs are in the foreground of current theoretical investigations The author must have felt, however, that these theories have not yet crystallized into a consistent system and are not secure enough to be included in a treatise of the character of a text- and hand book only one brief section is devoted to the positron On the other hand, there is attached to it a new chapter on the electromagnetic field theory which has attained in the last years a formally satisfactory character as a complete analogue to classical electrodynamics (although some deeper problems connected with the structure of the electron remain unresolved) A valuable new feature is an Index of Definitions' which was lacking in the first edition

PAUL S EPSTEIN

GARDEN PLANTS

The Genetics of Garden Plants By M CRANE and W J C LAWRENCE Foreword by Sir Daniel Hall Pp xxi, 236 53 figures 42 tables Macmillan and Company, London 1934 10s 6d

THE authors state in their preface that the object of this book is twofold first, to give an introduction to the essential principles of genetics and cytology, and secondly, to give an account of recent results in relation to horticulture

The first three chapters are devoted to a brief treatment of the genetics and cytology of diploid and polyploid plants The next chapter deals with flowering and ornamental plants Limitations of space preclude a discussion of all the work which has been done, so the authors confine their attention chiefly to those plants which have been most intensively investigated The sweet pea, garden stock, Chinese primrose, dahlia and snapdragon are considered and the chapter closes with brief comment on a number of interspecific hybrids The present reviewer would have welcomed a more detailed account of the work which Baur and his associates have carried on with *Antirrhinum*, but obviously in a general text covering such a wide field it is impossible to discuss any particular plant at great length

The tomato, garden pea, radish, lettuce, onion, beet, cucumber and potato are among the vegetable and salad plants discussed A long list of fruits is dealt

with, but even so a considerable number, including the citrus fruits, have been omitted. In the opinion of this reviewer the value of the book would have been considerably enhanced if it had been restricted in scope to the flowering and ornamental plants, or the vegetable and salad plants, or the fruits, thus permitting a more comprehensive review of a relatively limited field.

The chapters dealing with incompatibility and sterility are of great interest to both the geneticist and practical plant breeder. They show clearly the important progress which has been made in this field in recent years.

The final chapter outlines the modes of origin of new and improved forms of garden plants. A number of interesting cases of constant hybrids are given. Among other problems brief mention of breeding for disease resistance is included. This subject is receiving increasing attention and represents one of the most promising fields open to the plant breeder at the present time, so it might well have been given greater emphasis.

The book includes a glossary, bibliography and index. It is written in a clear and interesting way, and will doubtless be favorably received by both geneticists and plant breeders.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SAND AND WATER PARADOX

AT the March meeting of the Central Ohio Physics Club, Dr. G. E. Owen presented a startling experiment which apparently has not been completely explained. The apparatus consisted of a rubber bulb about 50 cc capacity with a glass tube, in which one could observe the water level at about half the length of the tube. When the bulb was squeezed, instead of an expected rise in level, the water was rapidly drawn into the bulb!

If the position of the level in the tube is to be considered as the indication of the pressure within the rubber bulb, then we have an interesting working model for that hypothetical part of van der Waals' equation where, indeed, a decrease in volume causes also a decrease in pressure.

The construction of the apparatus is made clear in Fig. 1, a, in its vertical cross section. The rubber bulb is tightly packed with sand up to the lower end of the glass tube, which is flared. A silk bolting cloth is stretched across the mouth of the tube to prevent sand from entering into the tube. Under ordinary conditions the grains of sand are so packed as to occupy the state of lowest potential energy which leaves the least volume between them. When the bulb is compressed, the spheres separate and the increased interstices draw in the water from the vertical tube. In a two-dimensional idealized diagram, Fig. 1, b, the

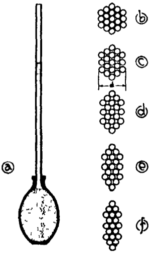

FIG. 1.

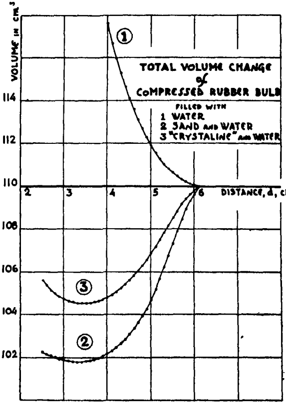

FIG. 2.

circles of equal diameters represent their original positions The area between the circles will reach a maximum when the circles are rearranged, as in d, on further compression the area will start to decrease, shown in e, returning finally to its original value, as in f, equal to that of b

To verify the above explanation an experimental set-up was made with a 100 cc rubber bulb between the parallel jaws of a milling machine vise The height of the water level was measured by means of a meter stick arranged parallel to the vertical tubing The tube was calibrated by measuring the volume of water that filled a certain length of the tube The distance d, between the jaws, was determined from the pitch of the screw The data are presented in form of three curves in Fig 2 Curve 1 was obtained for a bulb filled with water only Curve 2 shows how the water level changes with the distance d, when the bulb is tightly packed with the sand In Curve 3, the bulb was filled with small glass spheres, ranging from 0215″ to 0224″ in diameter These small spheres are produced by atomizing molten glass and are solidified in the air Surface tension is responsible for their perfect sphericity. They are used for decorative purposes under the name of "Crystaline" or "Glasscherben" These curves definitely show the minimum volume for water and sand or glass spheres and an increase in volume on further decrease in d As was expected, for the same change in d, the minimum is more pronounced with the glass spheres Because of larger frictional forces between the irregular grains of sand the interspacial volume for sand increases more rapidly and reaches larger value than in the case of glass spheres The limit of compression was set by the strength of the rubber bulb

The phenomenon described here is a familiar experience to those at the seashore who have noticed how rapidly the water "dries up" around foot prints when walking on the wet sand

Any of the readers who can give the reference to any publications concerning the described effect are kindly asked to communicate with the author

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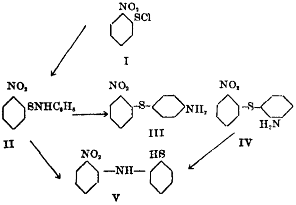
SPECIAL ARTICLES

MOLECULAR REARRANGEMENTS OF SULFANILIDES

DURING recent work in this laboratory on the development of improved methods for the synthesis of new sulphide phenol compounds possessing high antiseptic and germicidal power, it was discovered that certain sulphur compounds of the sulfanilide type are capable of undergoing profound molecular changes Two types of transformations have thus far been revealed in the course of our researches, which may be illustrated by the following example The starting point serving for our illustration is *o* nitrophenylsulfurchloride I, which is easily prepared by the action of chlorine on *o*-nitrophenyldisulphide This sulfurchloride I interacts smoothly with aniline to form in good yield *o* nitrophenylsulfanilide II We find that this latter compound II undergoes two types of molecular change, depending upon the experimental conditions employed (1) If the sulfanilide II is heated at a definite temperature, or if it is digested with its respective amine (aniline) at its boiling point, it is transformed into its isomeric 2 nitro 4′-aminodiphenylsulphide III In some cases we have also observed a corresponding *ortho* rearrangement IV (2) On the other hand, when the sulfanilide II is warmed in alcohol in the presence of sodium hydroxide it undergoes an entirely different type of change and is transformed smoothly into a mercapto diphenylamine derivative corresponding to formula V Regarding the mechanism of this last change we are not prepared to offer a decisive explanation The simplest postulation, that we are dealing here with the intermediate formation of an *ortho*-aminosulphide (formula IV), which then rearranges to the isomeric diphenylamine V, does not satisfy as the correct explanation The English chemist, Dr Smiles, and his co workers report[1] that *o*-aminosulphides of this type, studied by them, are unattacked by alcoholic sodium hydroxide, while the corresponding acetyl and benzoyl derivatives, for example, rearrange easily to diphenylamine derivatives under the same experimental conditions Two types of reaction products, therefore, are possible of



[1] See Evans and Smiles, *Jour Chem Soc* (London), p 183, 1935

formation by molecular rearrangement of a given sulfanilide We are interested in determining the structural configurations limiting the practical application of this double molecular rearrangement

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ISOLATION OF A CRYSTALLINE PROTEIN POSSESSING THE PROPERTIES OF TOBACCO-MOSAIC VIRUS

A CRYSTALLINE material, which has the properties of tobacco mosaic virus, has been isolated from the juice of Turkish tobacco plants infected with this virus The crystalline material contains 20 per cent nitrogen and 1 per cent ash, and a solution containing 1 milligram per cubic centimeter gives a positive test with Millon's biuret, xanthoproteic, glyoxylic acid and Folin's tyrosine reagents The Molisch and Fehlings tests are negative, even with concentrated solutions The material is precipitated by 0 4 saturated ammonium sulfate, by saturated magnesium sulfate or by safranine, ethyl alcohol, acetone, trichloracetic acid, tannic acid, phosphotungstic acid and lead acetate The crystalline protein is practically insoluble in water and is soluble in dilute acid, alkali or salt solutions Solutions containing from 0 1 per cent to 2 per cent of the protein are opalescent They are fairly clear between pH 6 and 11 and between pH 1 and 4, and take on a dense whitish appearance between pH 4 and 6

The infectivity, chemical composition and optical rotation of the crystalline protein were unchanged after 10 successive crystallizations In a fractional crystallization experiment the activity of the first small portion of crystals to come out of solution was the same as the activity of the mother liquor When solutions are made more alkaline than about pH 11 8 the opalescence disappears and they become clear Such solutions are devoid of activity and it was shown by solubility tests that the protein had been denatured The material is also denatured and its activity lost when solutions are made more acid than about pH 1 It is completely coagulated and the activity lost on heating to 94° C Preliminary experiments, in which the amorphous form of the protein was partially digested with pepsin, or partially coagulated by heat, indicate that the loss in activity is about proportional to the loss of native protein The molecular weight of the protein, as determined by two preliminary experiments on osmotic pressure and diffusion, is of the order of a few millions That the molecule is quite large is also indicated by the fact that the protein is held back by collodion filters through which proteins such as egg albumin readily pass. Collodion filters which fail to allow the protein to pass also fail to allow the active agent to pass The material readily passes a Berkefeld "W" filter

The crystals are over 100 times more active than the suspension made by grinding up diseased Turkish tobacco leaves, and about 1,000 times more active than the twice frozen juice from diseased plants One cubic centimeter of a 1 to 1,000,000,000 dilution of the crystals has usually proved infectious The disease produced by this, as well as more concentrated solutions, has proved to be typical tobacco mosaic Activity measurements were made by comparing the number of lesions produced on one half of the leaves of plants of Early Golden Cluster bean, *Nicotiana glutinosa* L, or *N langsdorffii* Schrank after inoculation with dilutions of a solution of the crystals, with the number of lesions produced on the other halves of the same leaves after inoculation with dilutions of a virus preparation used for comparison

The sera of animals injected with tobacco mosaic virus give a precipitate when mixed with a solution of the crystals diluted as high as 1 part in 100,000 The sera of animals injected with juice from healthy tobacco plants give no precipitate when mixed with a solution of the crystals Injection of solutions of the crystals into animals causes the production of a precipitin that is active for solutions of the crystals and juice of plants containing tobacco mosaic virus but that is inactive for juice of normal plants

The material herein described is quite different from the active crystalline material mentioned by Vinson and Petre[1] and by Barton Wright and McBain,[2] which consisted, as Caldwell[3] has demonstrated, largely of inorganic matter having no connection with the activity These preparations were less active than ordinary juice from diseased plants, and the activity they possessed diminished on further crystallizations

The crystalline protein described in this paper was prepared from the juice of Turkish tobacco plants infected with tobacco mosaic virus The juice was brought to 0 4 saturation with ammonium sulfate and the precipitated globulin fraction thus obtained was removed by filtration The dark brown globulin portion was repeatedly fractionated with ammonium sulfate and then most of the remaining color was removed by precipitation with a small amount of lead subacetate at pH 8 7 An inactive protein fraction was removed from the light yellow colored filtrate by adjusting to pH 4.5 and adding 2 per cent. by weight of standard celite The celite was removed, suspended in

1 C G Vinson and A W Petre, *Contrib Boyce Thompson Inst*, 3 131, 1931

2 E Barton Wright and A. McBain, *Nature*, 132: 1003, 1933

3 J Caldwell, *Nature*, 133: 177, 1934.

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